Topics

- DGEX Project Objective
- DGEX Configuration
- DGEX Technical Assessment
- DGEX Scientific Assessment
- Summary

DGEX Project Objective

- Provide NWS Forecast Offices With a First Guess National Digital Forecaster Database (NDFD) Eight Day Forecast Grid Derived from the Meso Eta Forecast Model
- Reduce the Effort Required for the WFO Forecaster to Create an Eight Day Forecast Grid for the Interactive Forecast Preparation System (IFPS)
  - GFS Grids Currently Distributed are Too Coarse in Vertical and Horizontal Resolution to Provide an Acceptable First Guess – Especially in Areas of Complex Terrain

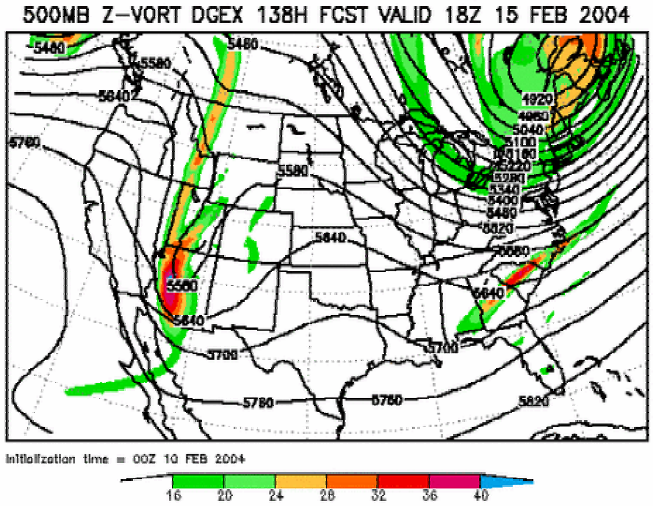
Downscaled GFS With Eta Extension (DGEX) Configuration

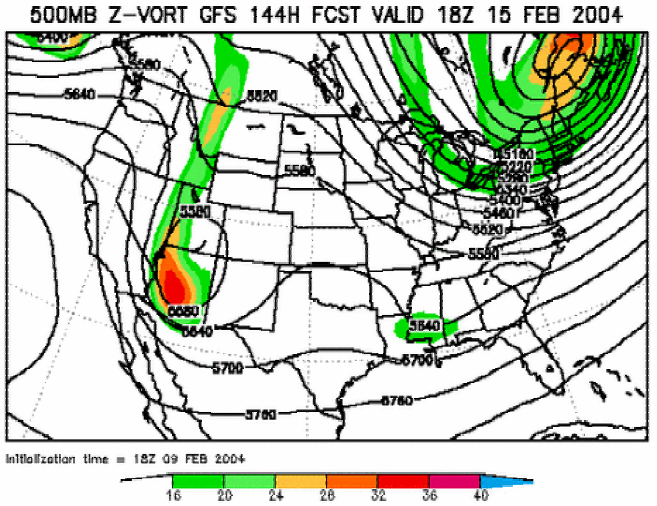
- Summary of Model Run Design
  - New 12 km Eta Run from 78-192 hr on Smaller Domain Using GFS Lateral Boundary Conditions (LBC)
    - Analogous to Downscaling GFS Since GFS Synoptic Scale Should Dominate Eta Solution in Its Interior
    - Start DGEX at 78 hr to Allow for Adjustment to Smaller Grid by 84 hr
    - 78-174 hr Uses 3-hr GFS LBC; 174-192 hr Uses 6-hr GFS LBC

DGEX vs. GFS (previous)

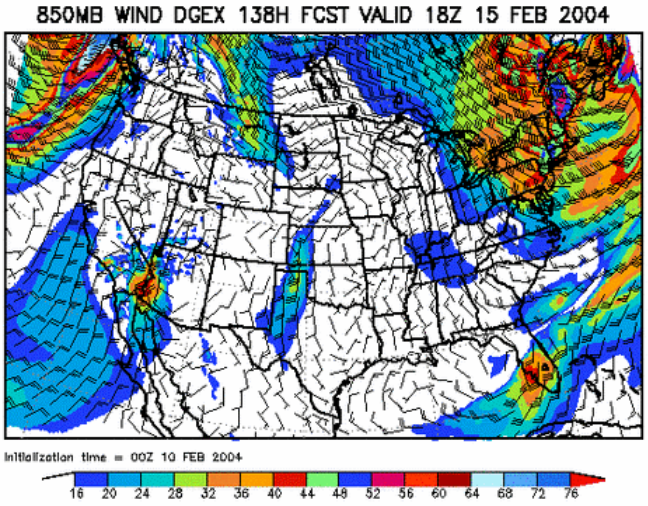
http://wwwt.emc.ncep.noaa.gov/mmb/mmbpll/dgexhome.ops/

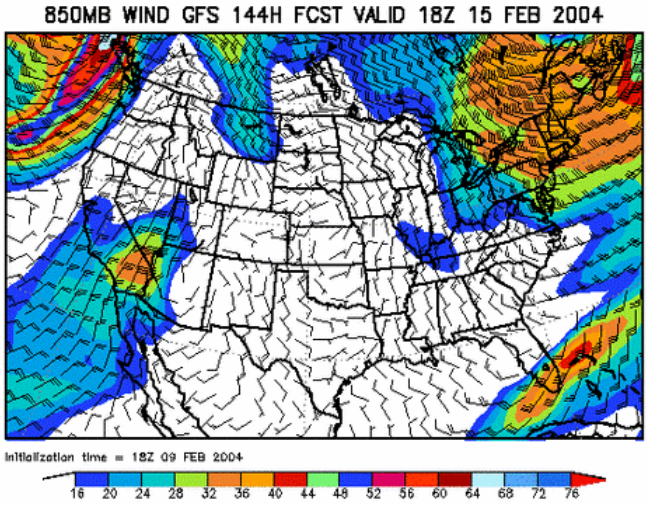
500 mb ht/Vort





850 mb wind

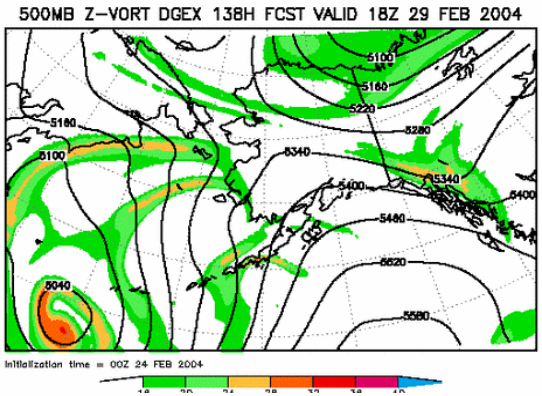


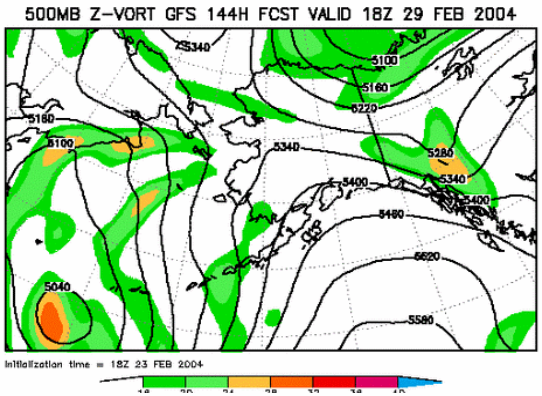


Alaska DGEX vs. GFS (previous)

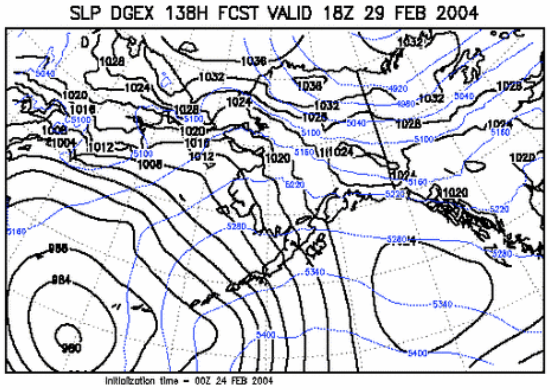
http://wwwt.emc.ncep.noaa.gov/mmb/mmbpll/dgexhome.ops/

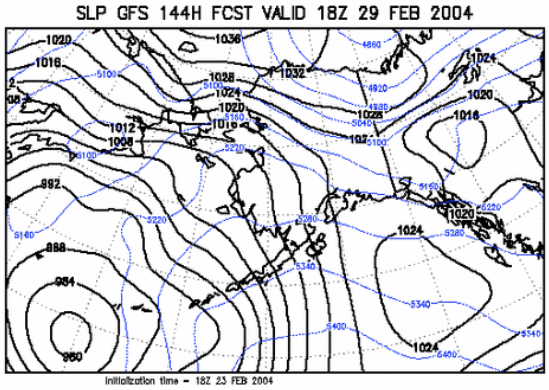
500 mb ht/Vort





SLP

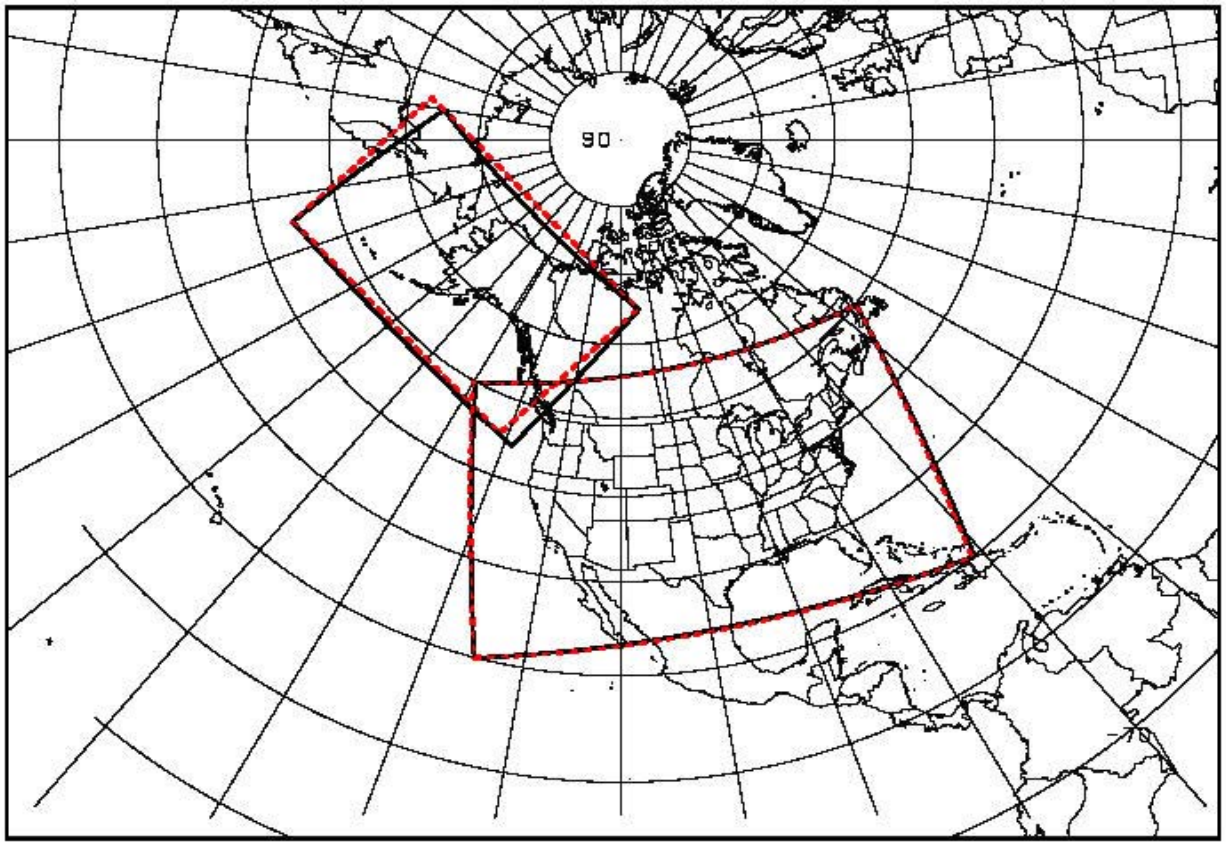




DGEX Configuration

- Cycle Times – Run Twice per Day per Grid
  - 06 and 18Z (00 and 12Z GFS LBC) for CONUS
  - 00 and 12Z (06 and 18Z GFS LBC) for Alaska
- Products Disseminated Through the TOC to the NCF Onto the SBN TG2 Channel
  - Formatted in GRIB2 With Compression
  - Output from 90-192 hr in Six Hour Increments
  - Limited Number of Forecast Parameters Output for Intended Use Within IFPS/NDFD

DGEX Domains



Solid black = DGEX integration grid; Dashed red = DGEX output grid

DGEX Parameters

- Pressure at Surface
- Pressure at MSL (Eta & Normal Reduction)
- T at 7 Levels: 2m, 0-30mb,30-60mb,60-90mb,90-120mb,120-150mb,150-180mb
- RH at 7 Levels: 2m,0-30mb,30-60mb,60-90mb,90-120mb,120-150mb,150-180mb
- Uwind at 7 Levels: 10m,0-30mb,30-60mb,60-90mb,90-120mb,120-150mb,150-180mb
- Vwind at 7 Levels: 10m,0-30mb,30-60mb,60-90mb,90-120mb,120-150mb,150-180mb
- Total Precip at Surface
- Total Cloud Cover
- Max Temperature at 2meter
- Min Temperature at 2meter
- Terrain height
- Synoptic Parameters (for Assessment of Model Synoptics):
  - 1000 mb - Height
  - 850 mb - Height Temperature Relative Humidity Wind
  - 700 mb - Height Temperature Relative Humidity Wind Omega
  - 500 mb - Height Temperature Relative Humidity Wind
  - 250 mb - Height Wind
  - Lifted Index (Surface Based)

DGEX Configuration

- Compressed 0-84 hr 12 km Eta Production Time Window
  - 60-84 hr 12 km Eta Extension Moved into 0-60 hr 12 km Eta Time Window
  - Completed 20 April 2004
- New DGEX Run Will Use Previous 60-84 hr 12 km Eta Extension Time Window in Production

DGEX Technical Assessment

- Testing Summary
  - EMC Parallel Testing
    - February 2004 – 23 April 2004
    - WFO Assessment Group
      - 15 March-23 April 2004
  - Codes Received by NCO on 1 April 2004
  - NCO Initial Test and Validation on 5 April 2004
  - NCO Parallel Testing (Four Cycles Run Daily)
    - 6 April 2004 – Present
    - No Code Failures
    - WFO Assessment Group
      - 23 April 2004 - Present

DGEX Technical Assessment

- Analysis of Product Content
  - GRIB2 Products Sent to TOC Bound for SBN
    - 90 Meg/Cycle for 06 and 18 UTC
    - 48 Meg/Cycle for 00 and 12 UTC
    - Product Distribution Coordination Through DRG
  - GEMPAK Files Sent to NCEP Centers
    - 30 Meg/Cycle
    - Products Reviewed by HPC Medium Range Desk
  - Total File Storage on IBM CCS
    - 7 Gig/Day

DGEX Technical Assessment

- Analysis of Production Resources

	Production (12 km Eta Extension 60-84 hr)		Proposed (DGEX 78-192 hr)	
Job Type	Nodes/Tasks	Average Runtime (Min)	Nodes/Tasks	Average Runtime (Min)
Fcst Job	44/176	42	44/176	30 (00/12 UTC) 42 (06/18 UTC)
Post Job	3/12	4	1/1	1
Prdgen Job	1/4	5	1/1	0.5

DGEX Fits Within Old 60-84 hr 12 km Eta Extension Time Window

DGEX Technical Assessment

- NCEP Model Implementation Process
  - NCEP Charter Created (02/25/04)
  - NCEP Director Briefed (03/11/04)
  - Objective Assessment Began (03/01/04)
  - Subjective Assessment Began (03/15/04)
  - Technical Assessment Began (04/01/04)
  - Assessments Compiled (04/23/04)
  - NCEP Director Briefed (05/??/04)
  - OS&T/OCWWS/OCIO Brief (05/??/04)
  - Proposed Implementation Date (05/27/04)

DGEX Technical Assessment

- Technical Summary
  - Code Changes Run Without Failure
  - New Products Are Formatted and Sized Correctly to Fit Within Current Infrastructure
  - Production Resource Utilization
    - DGEX Occupies the Same Production Schedule and Resource Time Slot as the Previous Eta Extension

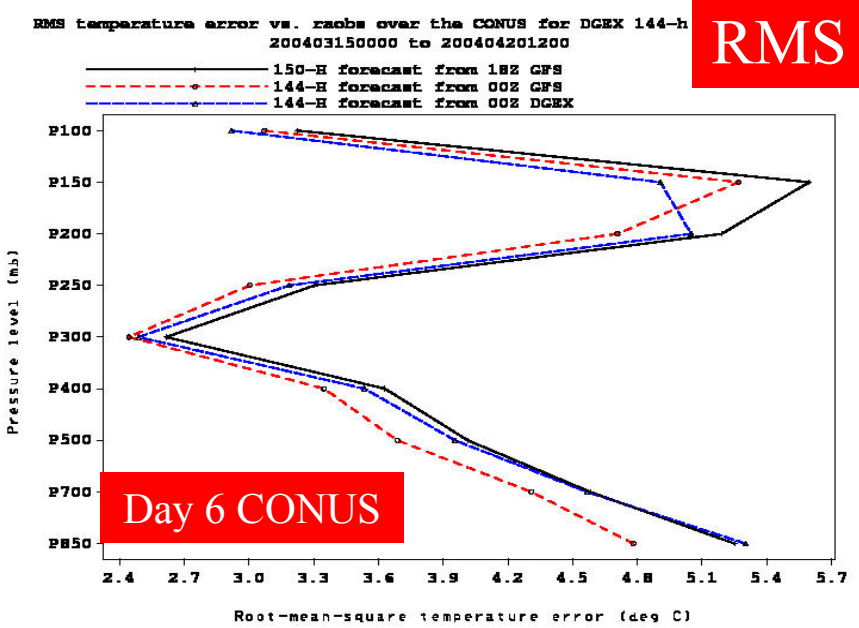
DGEX Scientific Assessment

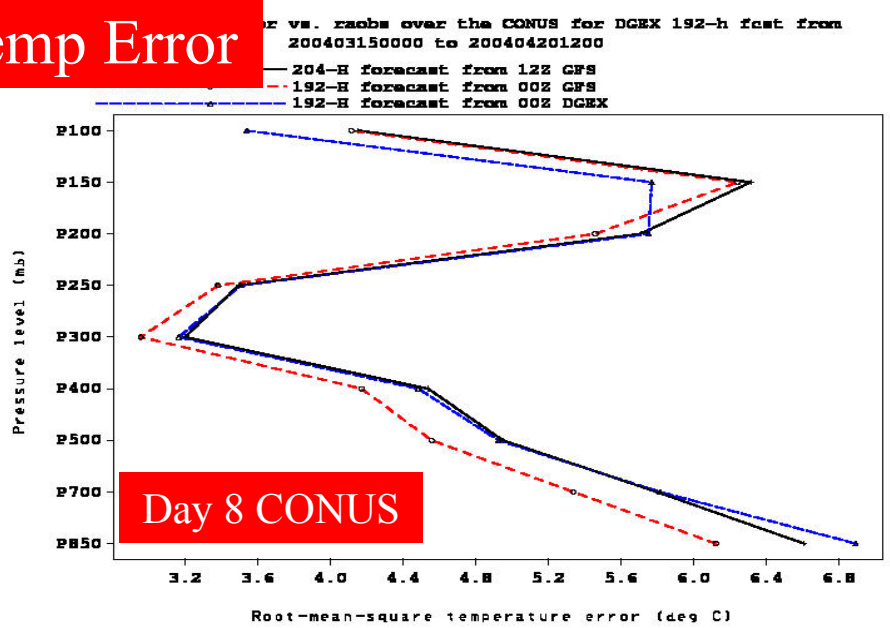
- 15 March – 20 April: Test and Evaluation period
  - 00 UTC DGEX Run Each Day in Development
    - CONUS Domain
    - Alaska Domain
  - EMC Objective Verification
    - DGEX and GFS (to Day 8) Ingested into EMC's FVS System For Quantitative Assessment: DGEX Near-Surface Performance and "Usability"
    - http://wwwt.emc.ncep.noaa.gov/mmb/mmbpll/dgexhome/pllstats.dgex/
  - WFO Subjective Assessment Led By ISST
  - NCEP HPC Subjective Assessment

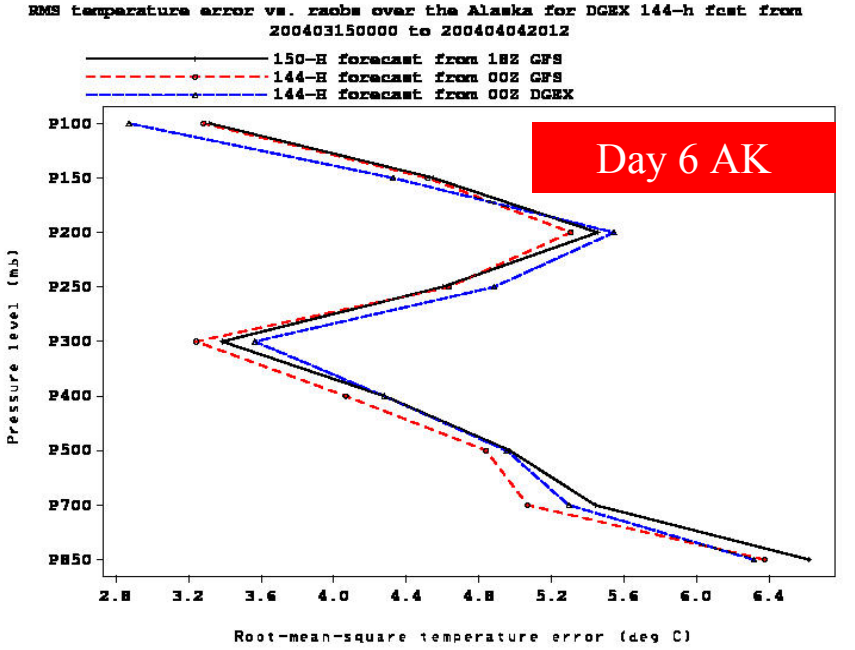
EMC Objective Verification Summary

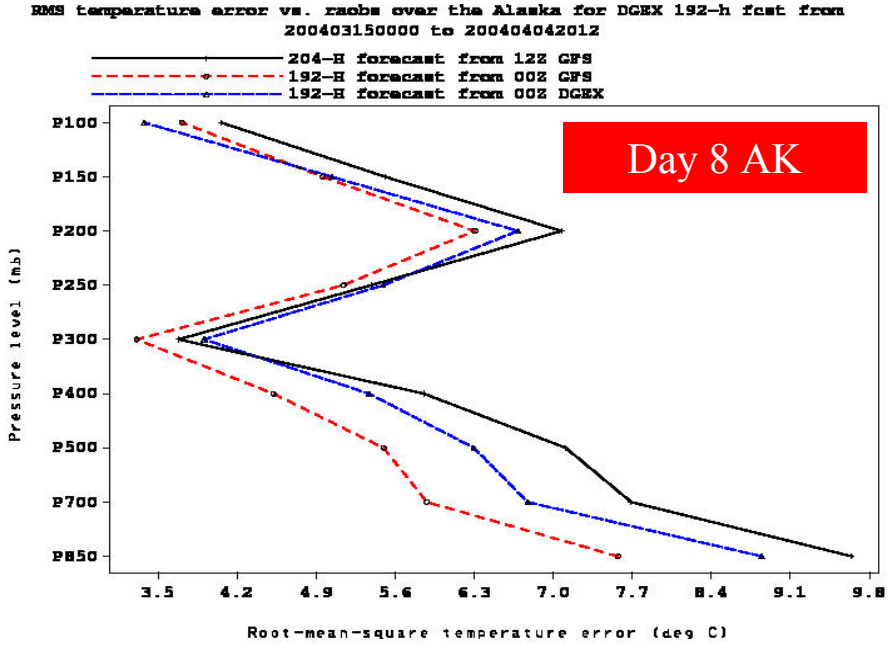
- Upper-level Verification vs Raobs
  - DGEX Errors Comparable or Slightly Better Than 6-h Old GFS Run Providing Boundary Conditions

RMS Temp Error



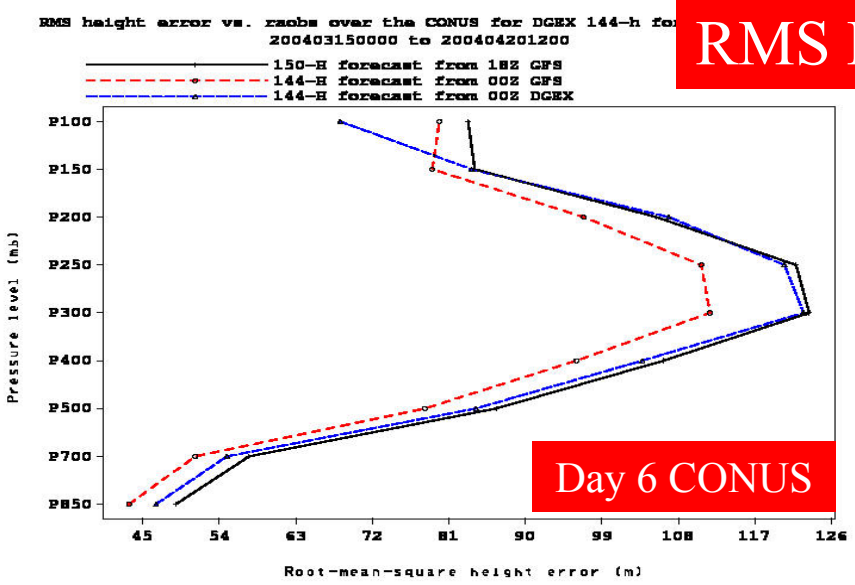


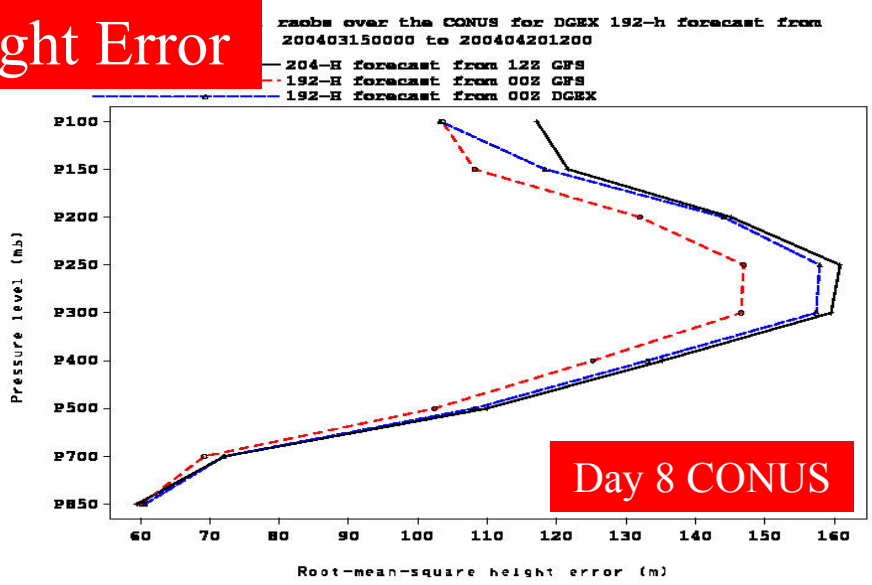


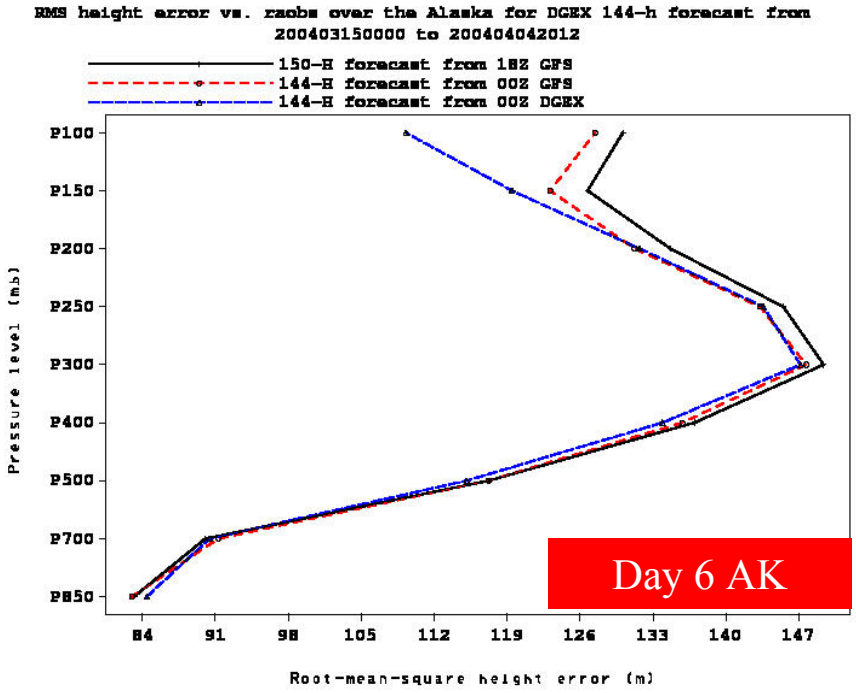


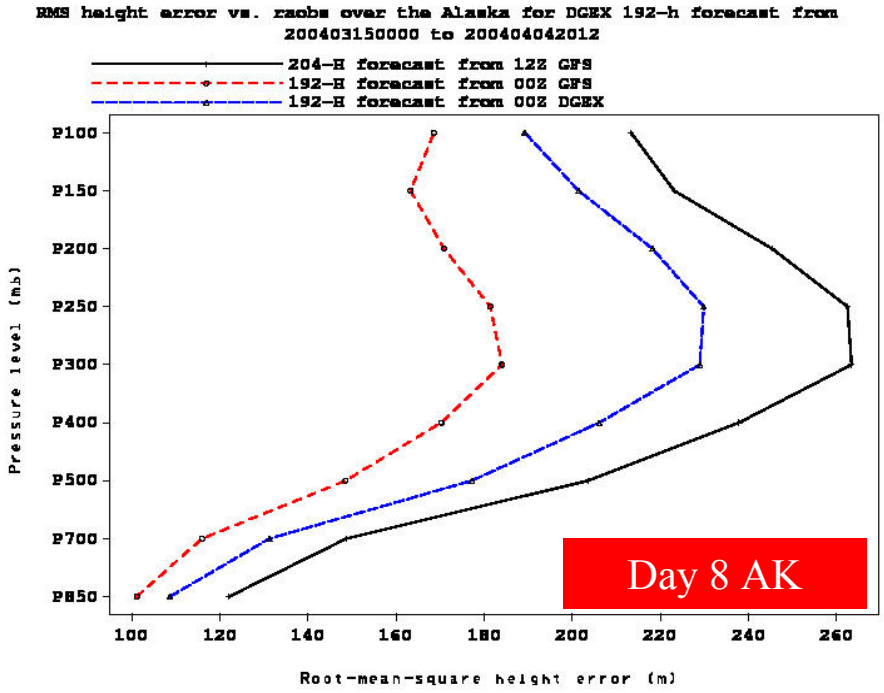
Black = 18Z GFS ; Red = 00Z GFS ; Blue = 00Z DGEX

RMS Height Error









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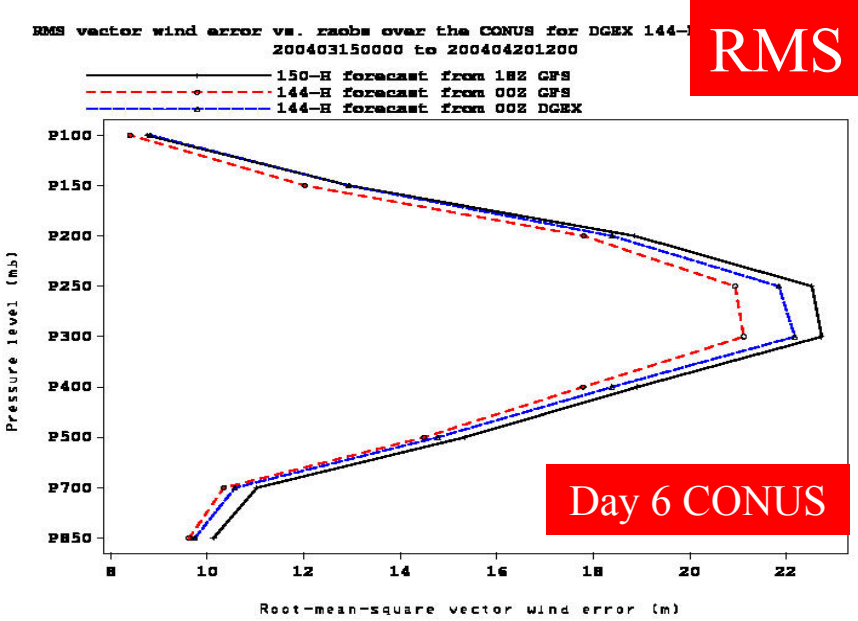
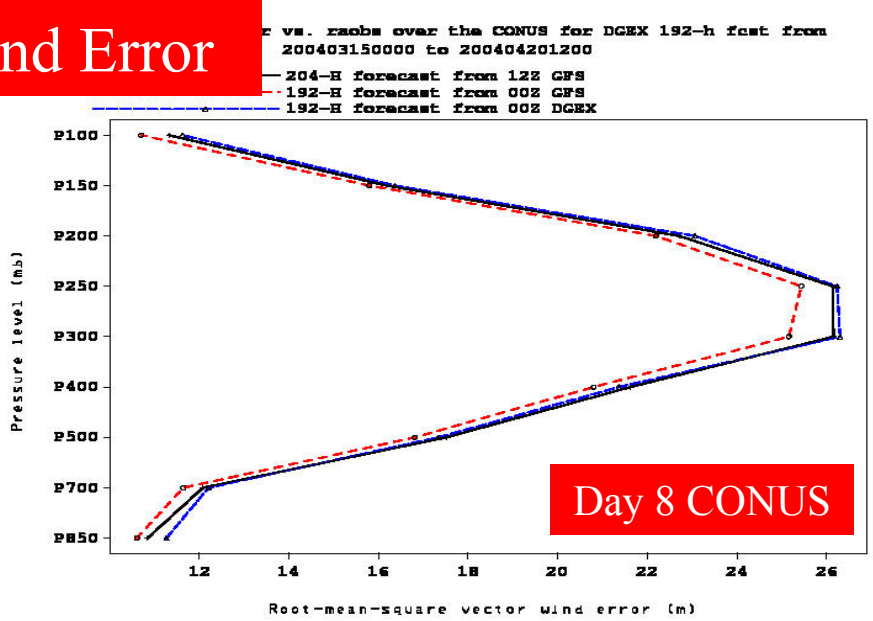
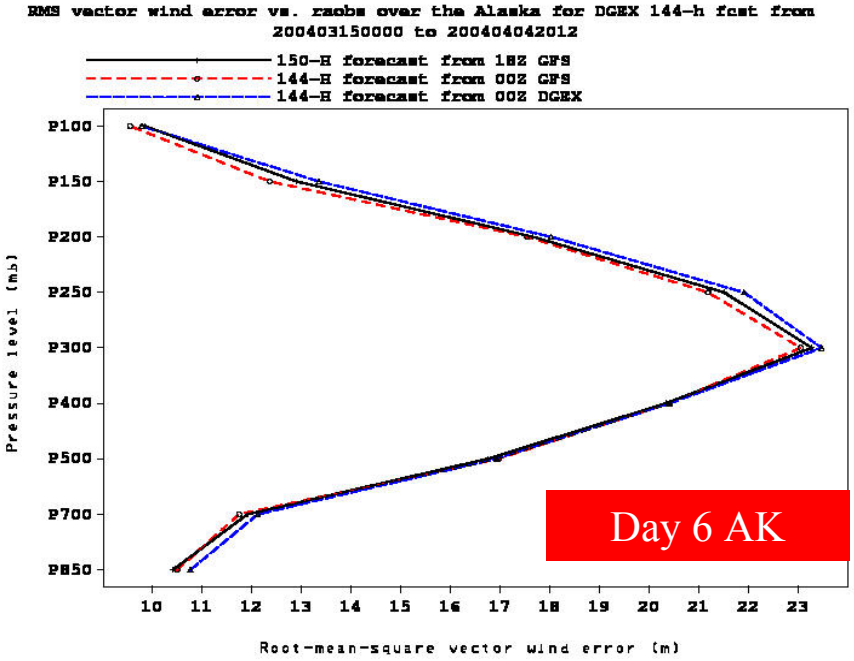
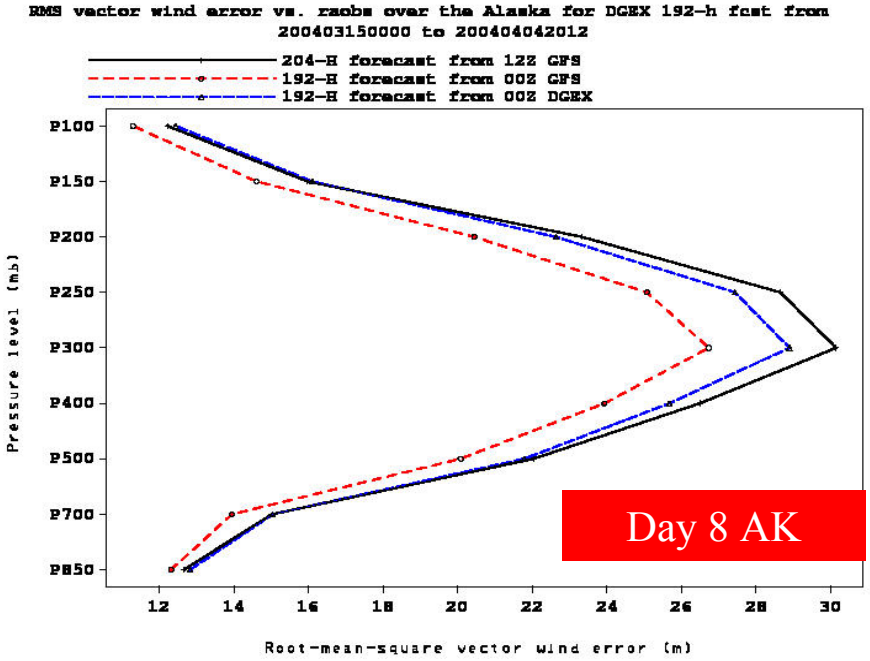
RMS Wind Error









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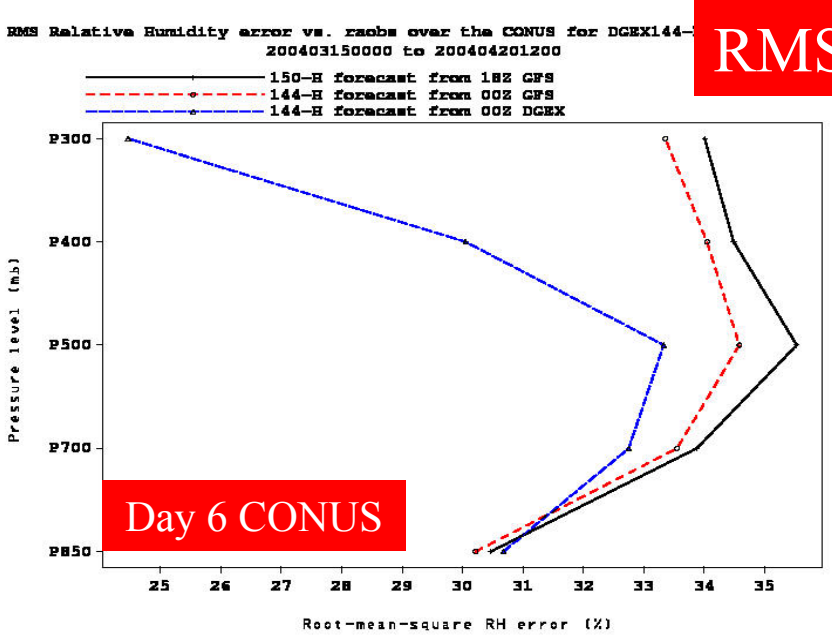
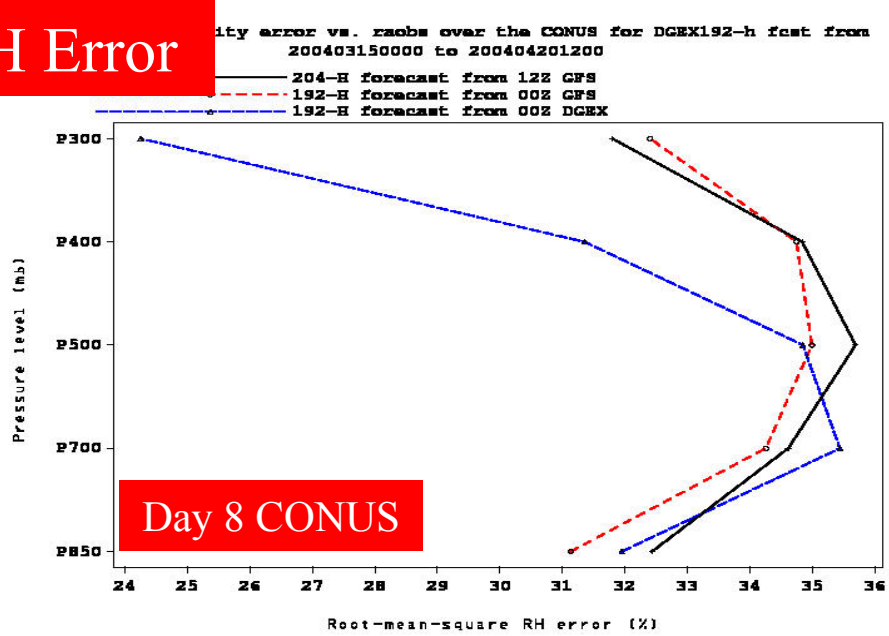
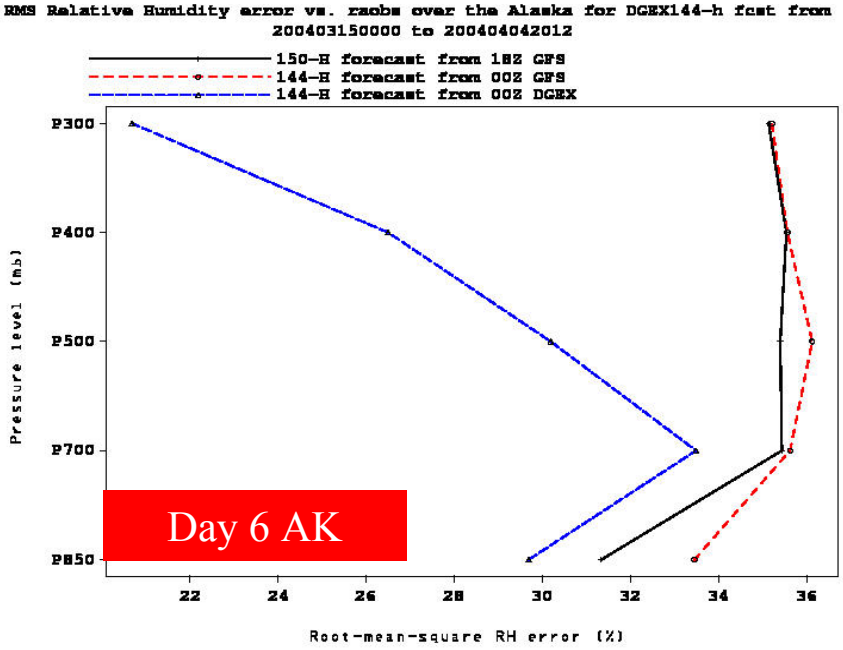
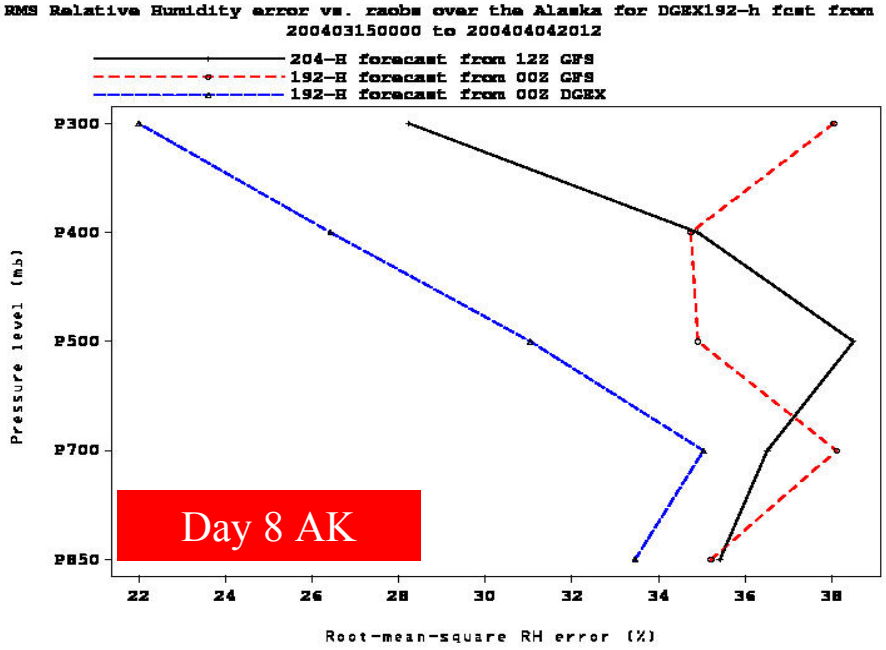
RMS RH Error









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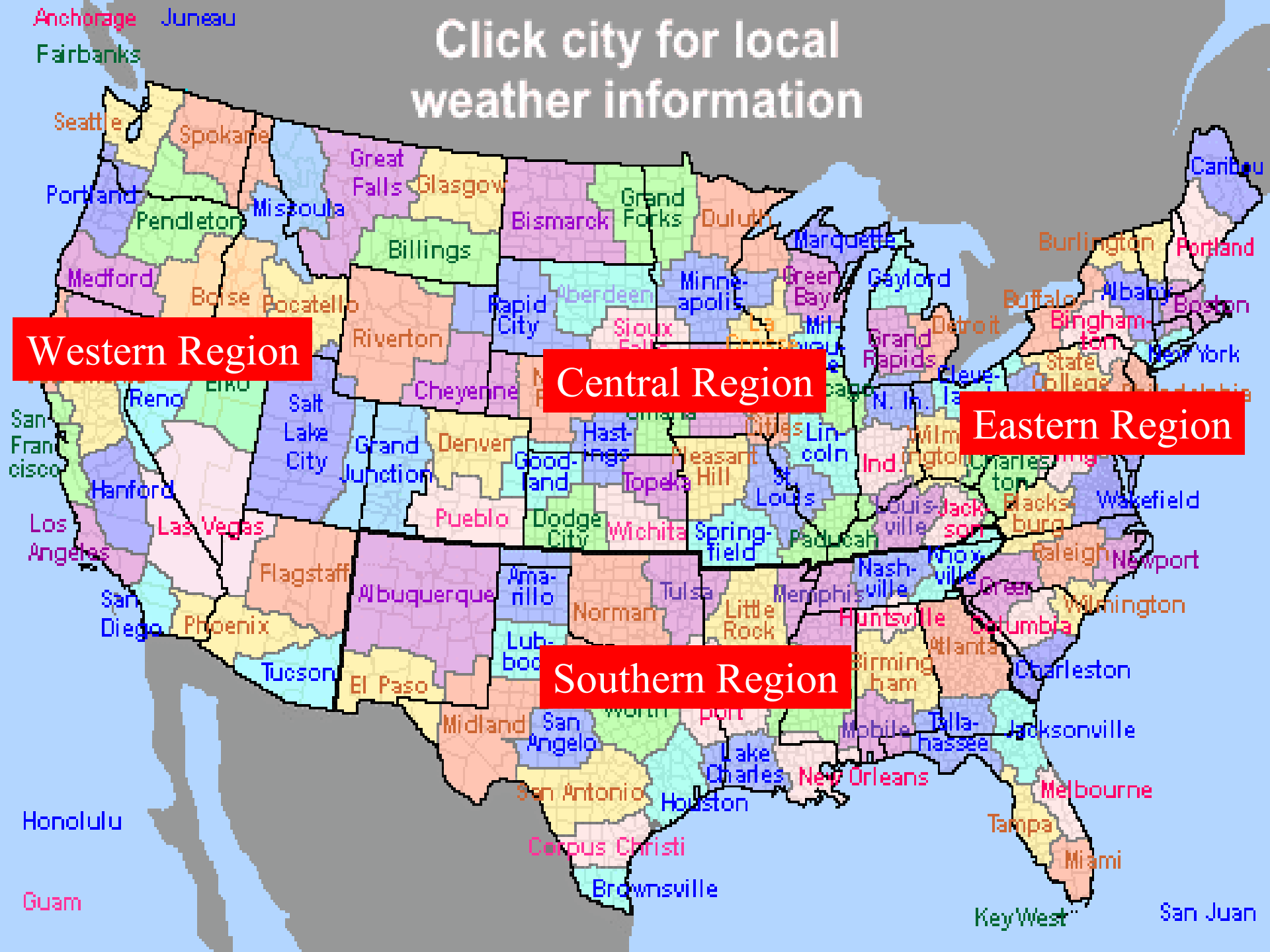
EMC Objective Verification Summary

- Near-Surface Verification of Temperature Winds
  - Mean DGEX 2-m Temperature Forecasts Closer to Observed Mean Than GFS for All Regions Except Nighttime Minimum in Alaska
    - DGEX Does Best in Western Region
  - Much More Diurnal 10-m Wind Speed Variations Then GFS
    - WFOs Liked DGEX Wind Directions Over GFS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Western Region
Central Region
Eastern Region
Southern Region
Anchorage
Juneau
Fairbanks
Seattle
Spokane
Portland
Pendleton
Missoula
Great Falls
Glasgow
Billings
Bismarck
Grand Forks
Duluth
Marquette
Caribou
Burlington
Portland
Medford
Boise
Pocatello
Rapid City
Aberdeen
Minneapolis
Green Bay
Gaylord
Buffalo
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Boston
Binghamton
Riverton
Sioux Falls
Grand Rapids
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State College
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Elko
Salt Lake City
Cheyenne
Grand Junction
Denver
Hastings
Goodland
Topeka
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Lincoln
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Atlanta
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Columbia
Charleston
Midland
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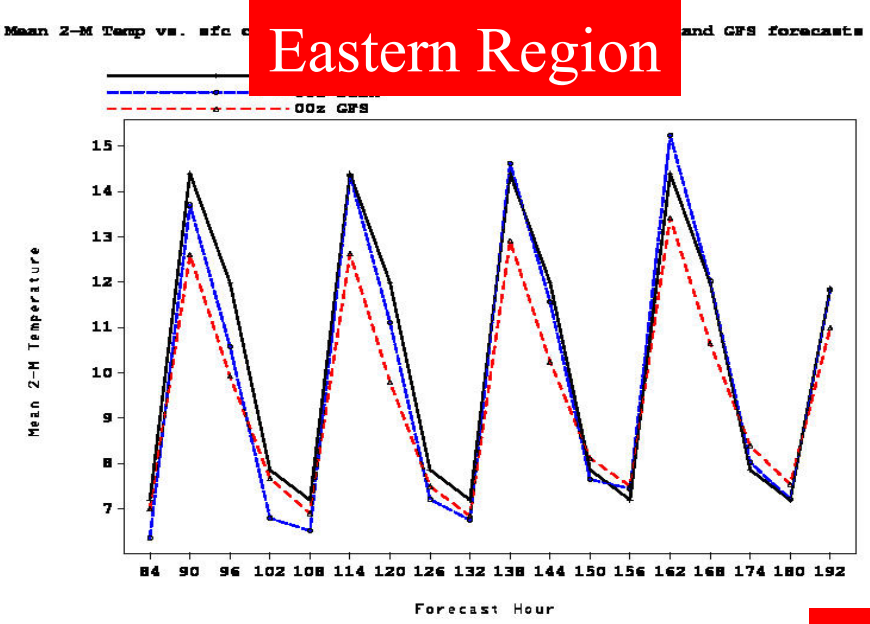
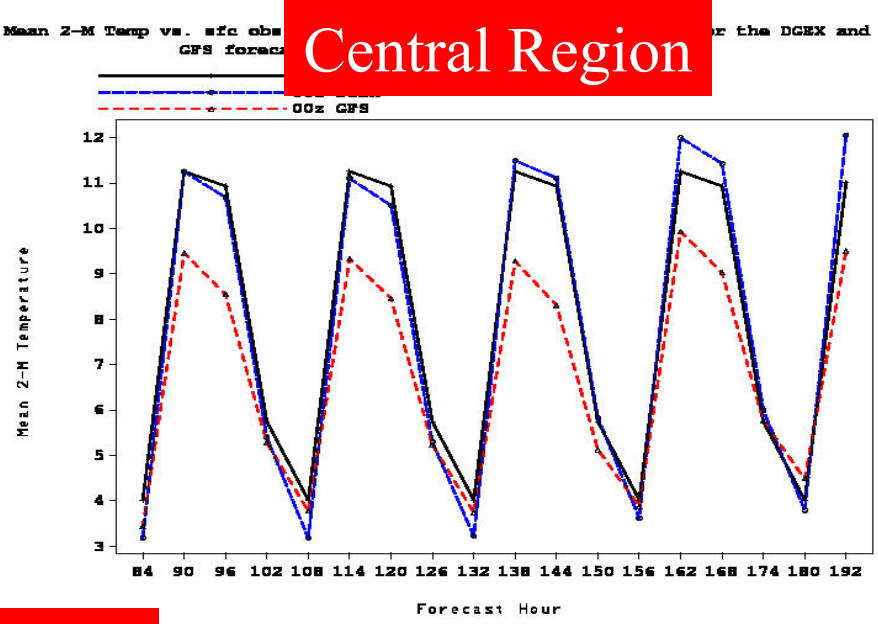
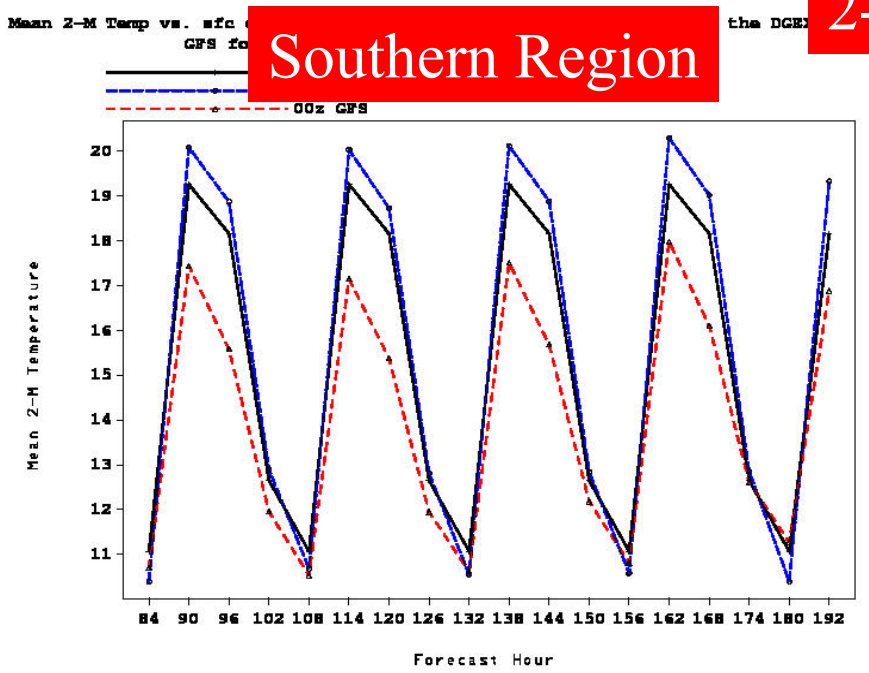
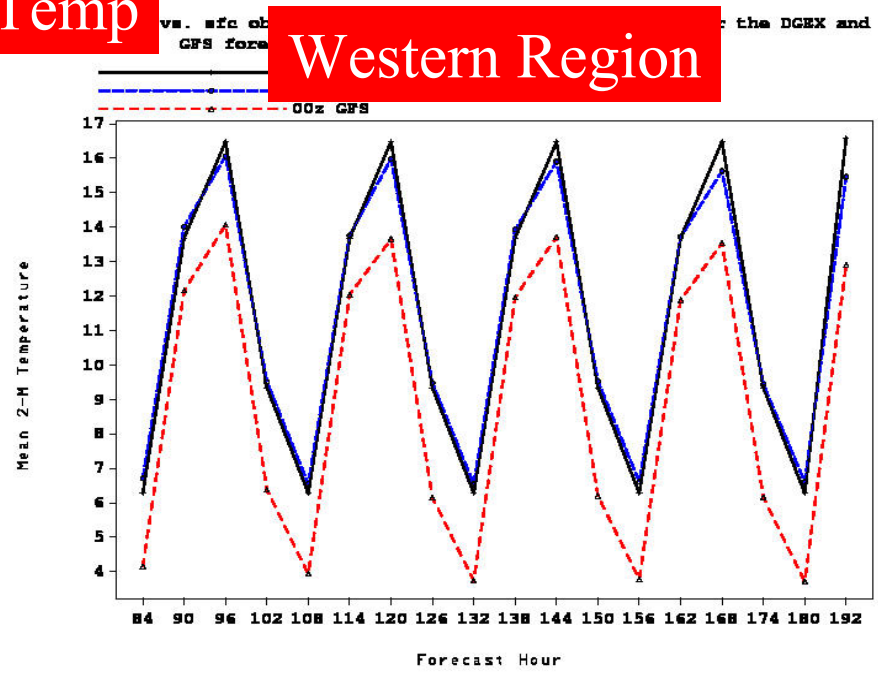
Guam
Key West
San Juan





2-m Temp

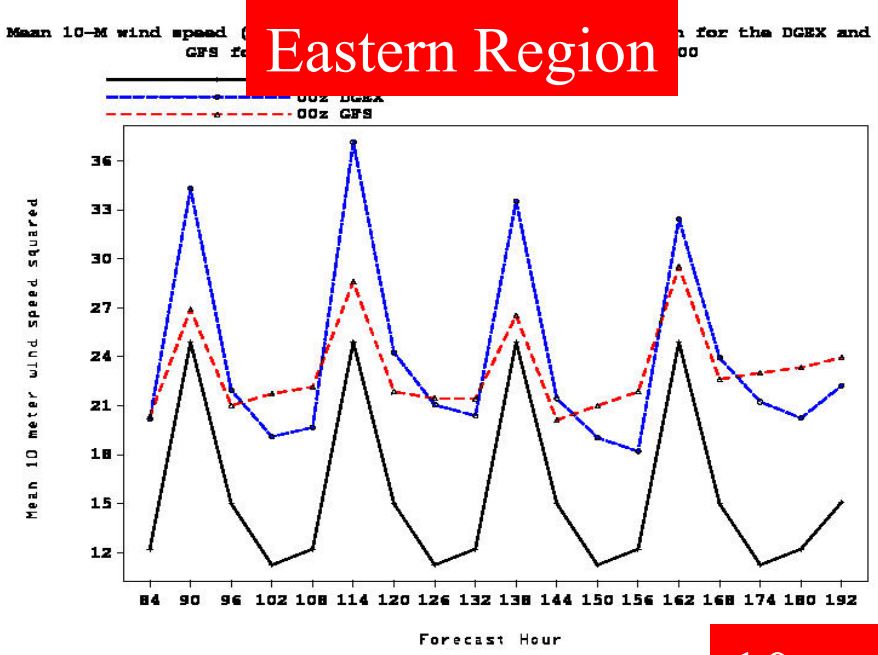




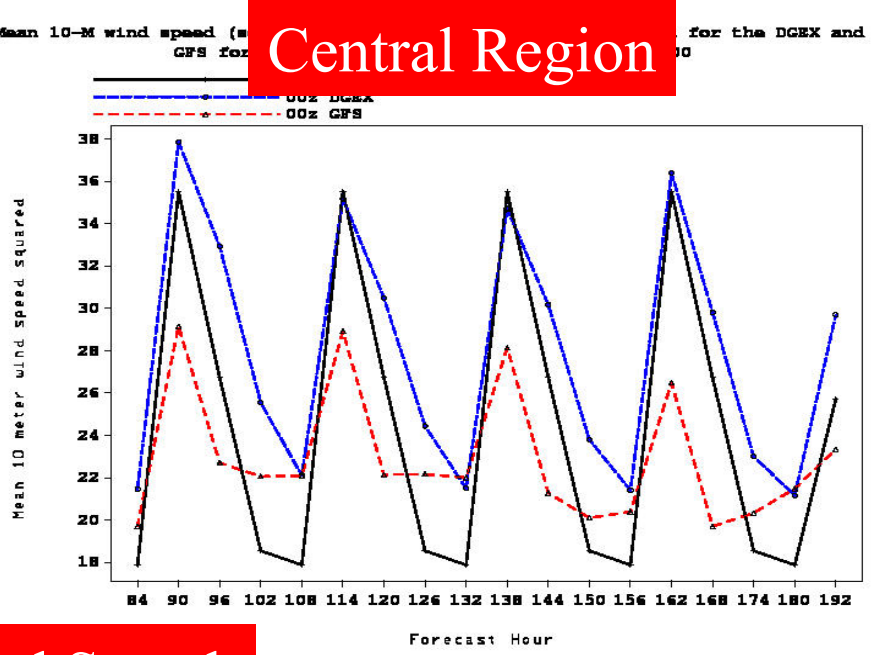
Black = Observed mean ; Red = 00Z GFS ; Blue = 00Z DGEX

10-m Wind Speed

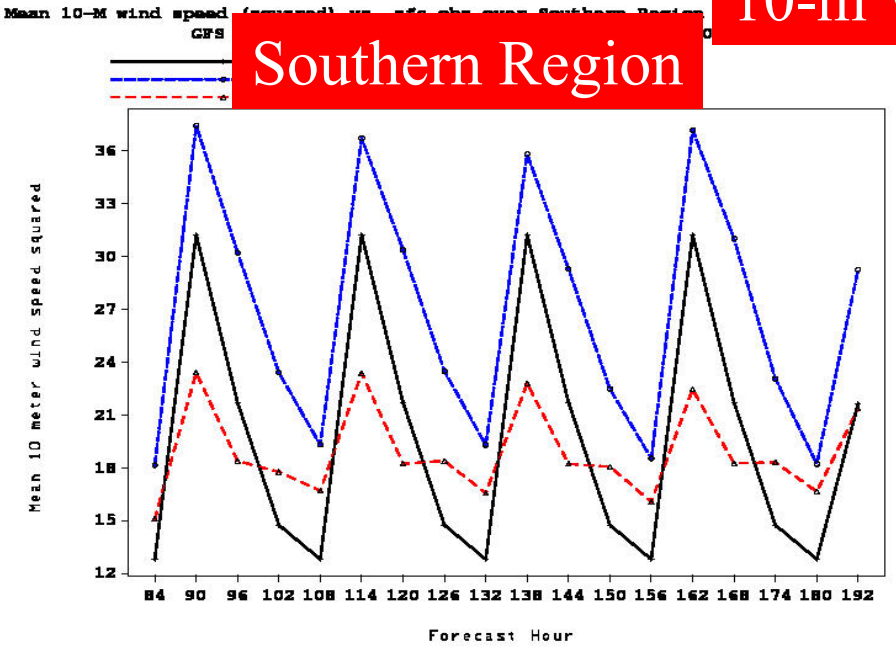
Eastern Region



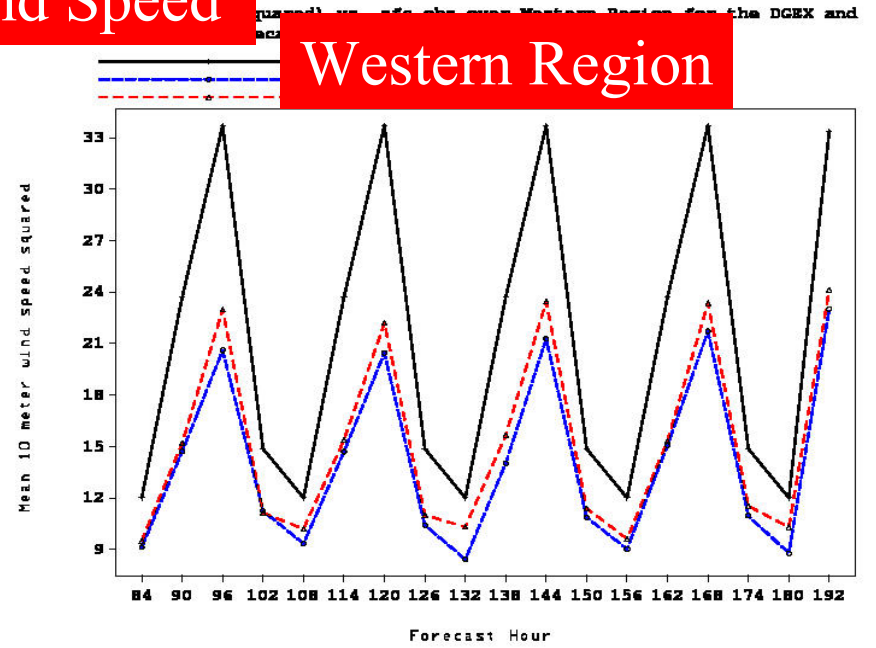
Central Region



Southern Region



Western Region



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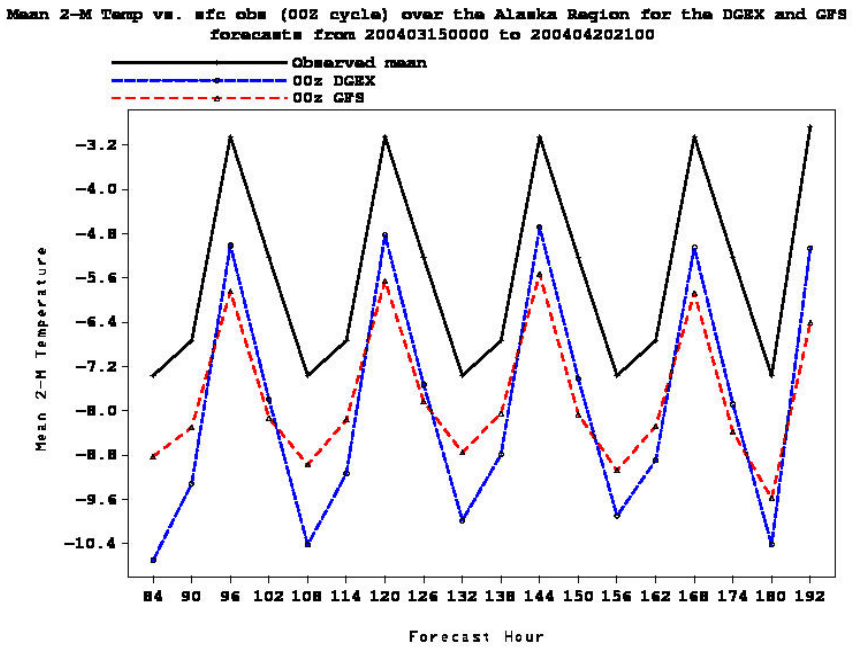
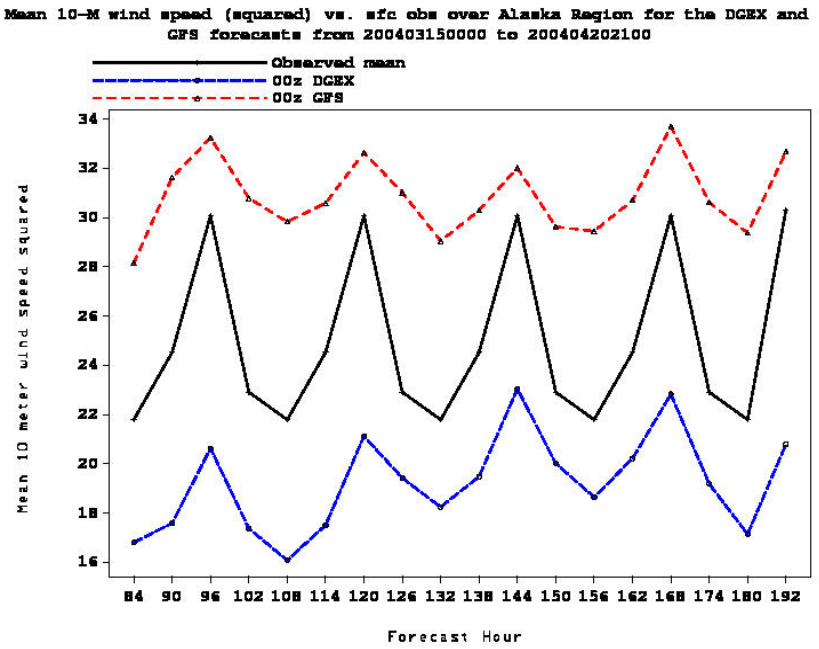
2-m Temp



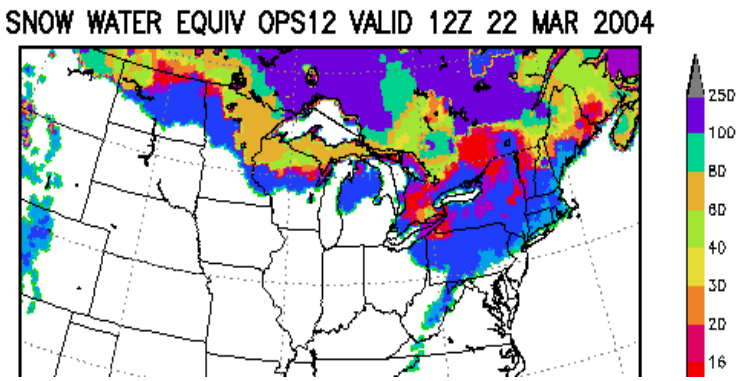
10-m Wind Speed

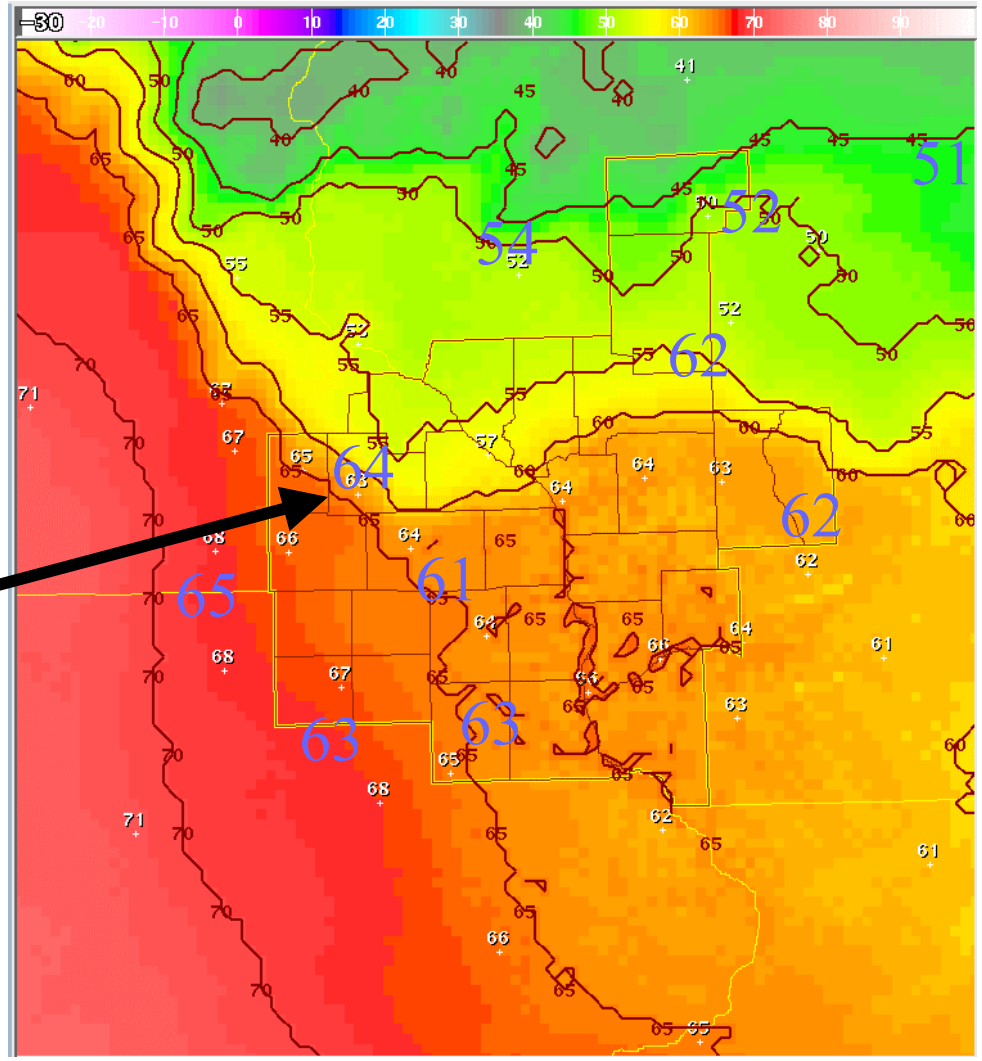


Alaska Region

Black = Observed mean ; Red = 00Z GFS ; Blue = 00Z DGEX

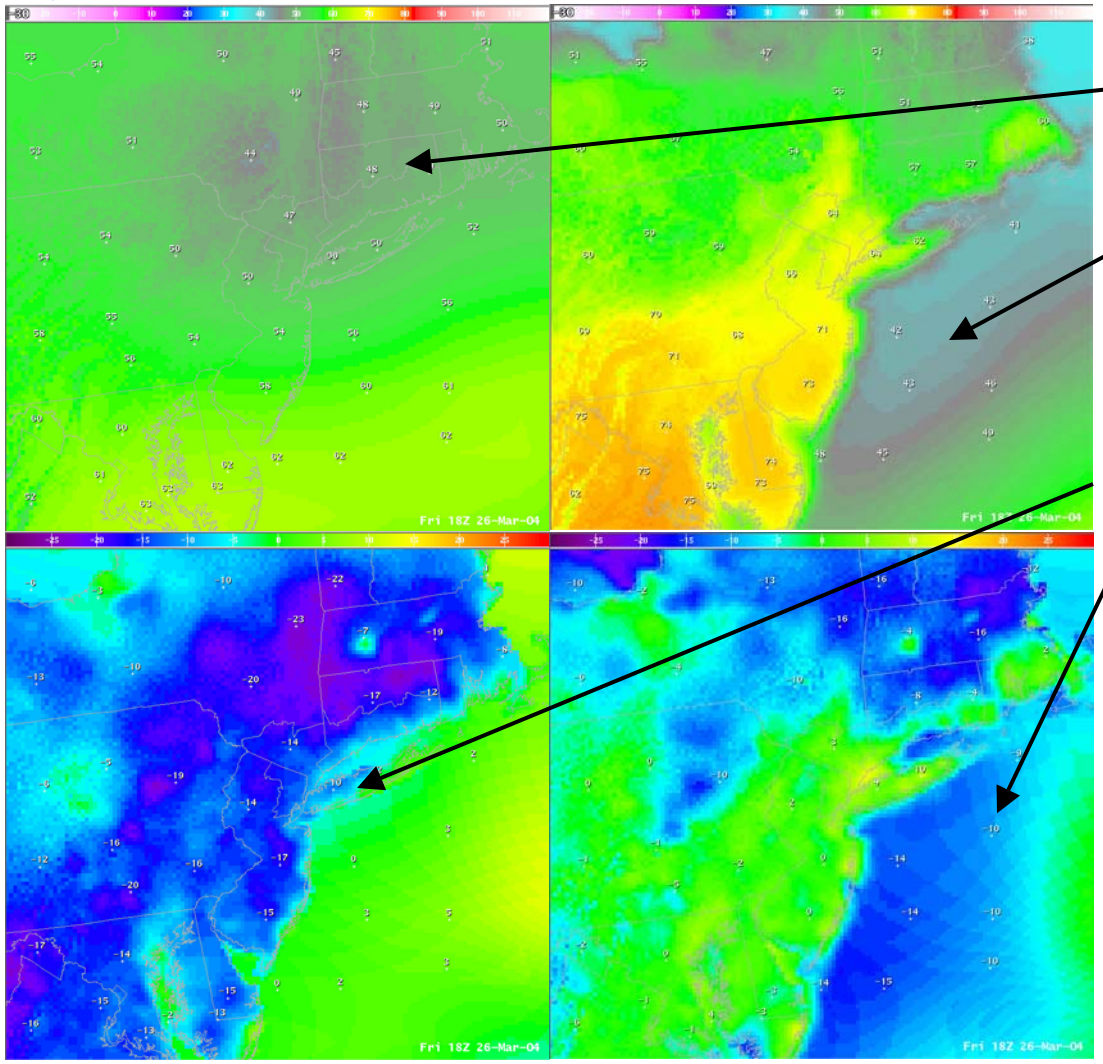
LaCrosse Example – from Dan Baumgardt





- Eta Snow Cover Reflected in the Day 4 MaxT Grid
- Verified Temps in Blue
- DGEX Very Useful to Modify Forecast MaxT

ER Example – from Dave Novak

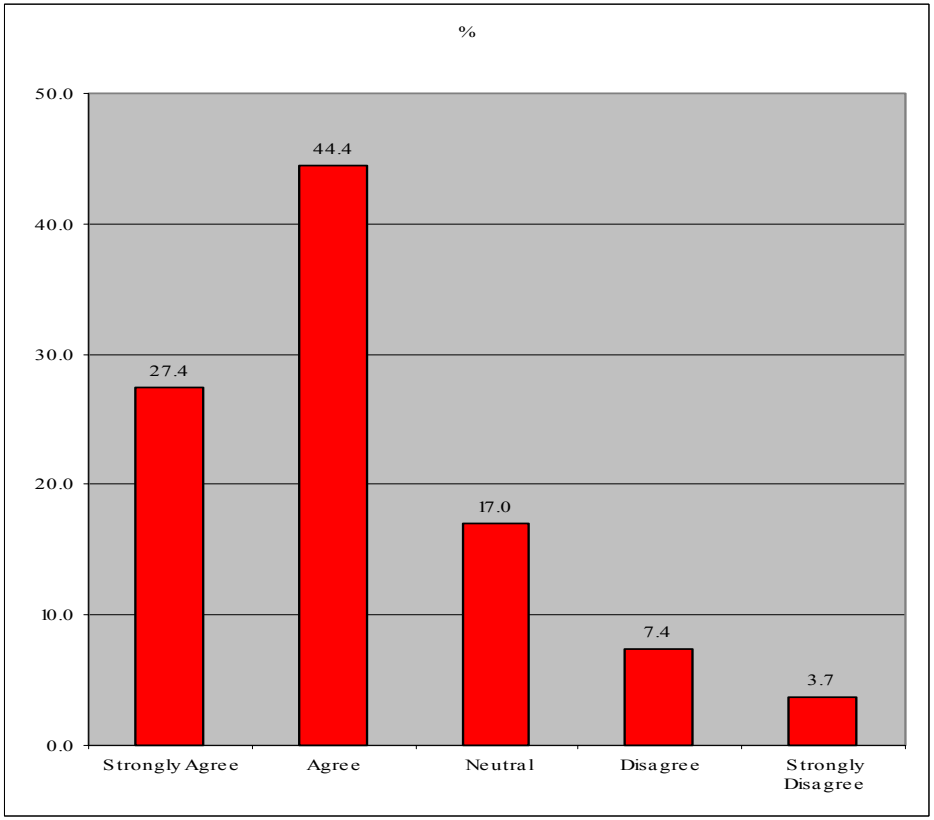


- 90 hr GFS Forecast Verifying 18Z March 26
- 90 hr DGEX Forecast Verifying 18Z March 26
- LAPS Used as "Ground Truth"
- GFS Forecast Error
- DGEX Forecast Error
- DGEX Significantly Reduces the Error

ISST Subjective Assessment

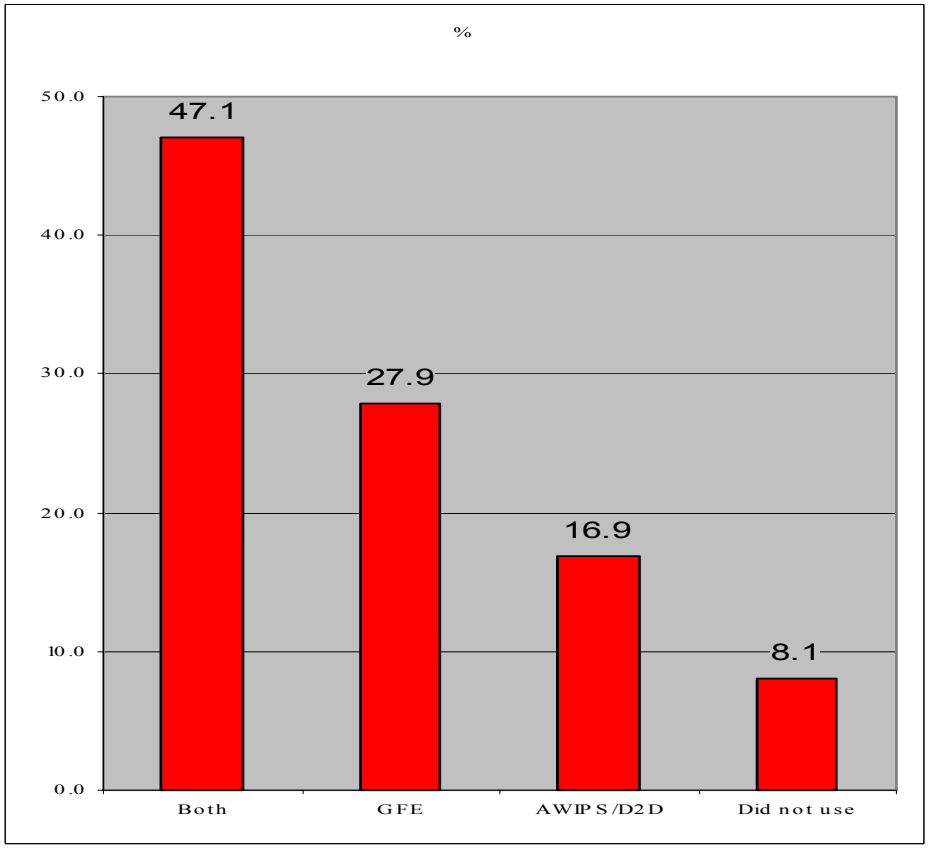
- 10 WFOs Participated in Assessment
  - 9 CONUS WFOs and Fairbanks, Alaska
- Data Sent via Regional WANs
- On-line Survey to Subjectively Assess DGEX on Daily Basis
  - 11 Questions
  - Filed After Shift Responsible for Inputting Day 7 Into the Grids
  - 135 Surveys Returned With Feedback

ISST Assessment Results - Daily Survey



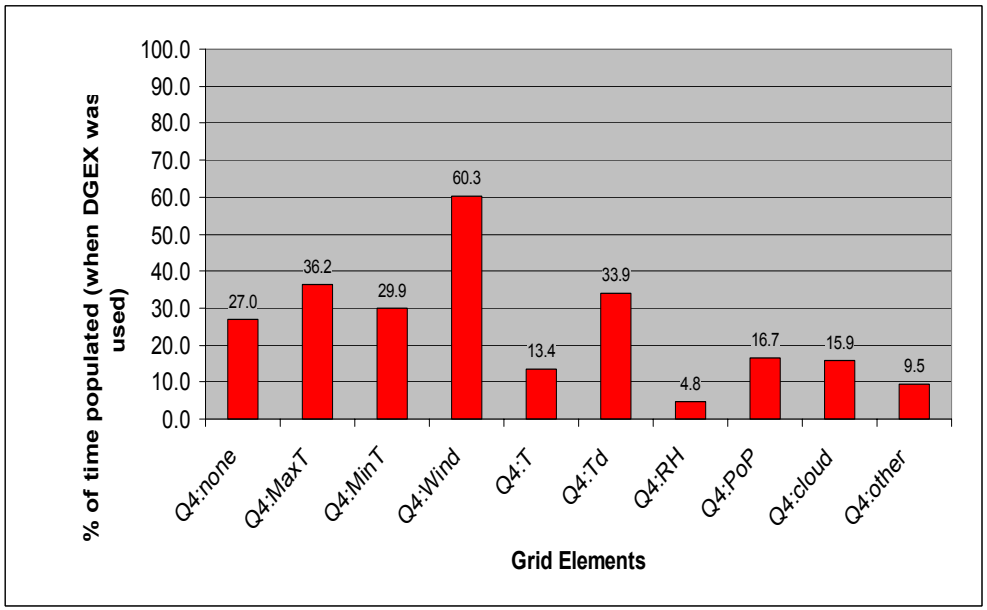
- Survey Question 2: The Timeliness of the DGEX Did Not Reduce Its Usefulness in the Forecast Process.
- Only ~10% Feel Timeliness Was an Issue
- Will Be Less of an Issue in the Operational Implementation

ISST Assessment Results - Daily Survey



- Survey Question 3: Did You Use the DGEX in Any Part of the Forecast Process on Your Shift?
- Generally Used in D2D & GFE or Just GFE

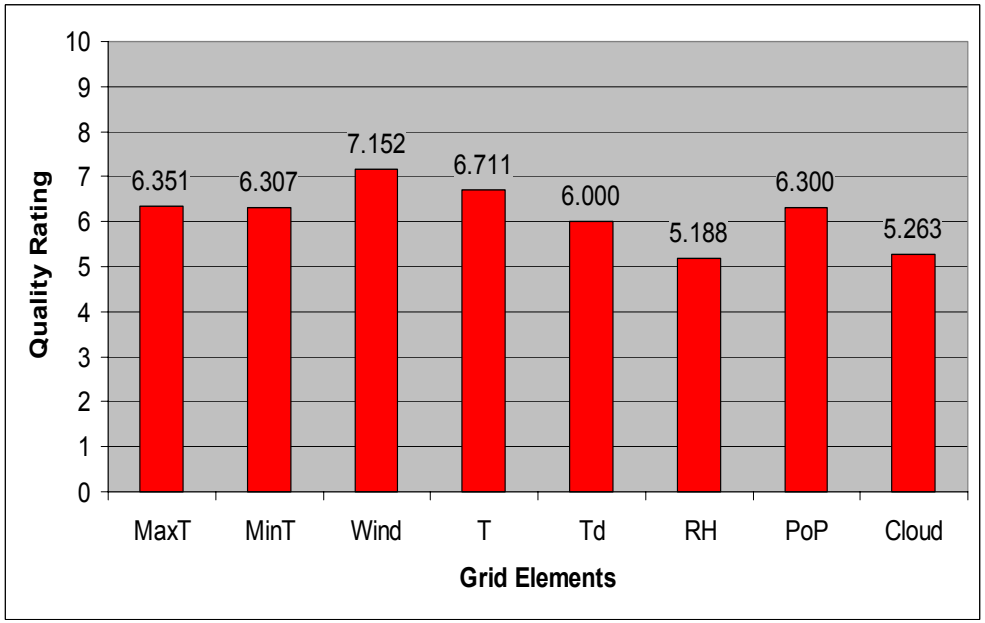
ISST Assessment Results - Daily Survey



- Survey Question 4: Which Grid Elements Were Populated in Some Form and/or For Some Time Period with the DGEX?

- Wind By Far Most Popular
- MaxT, MinT, T_d Next
- T, RH, Pop, Cloud Least Popular
- Other: Wx, Snow Level, QPF

ISST Assessment Results - Daily Survey

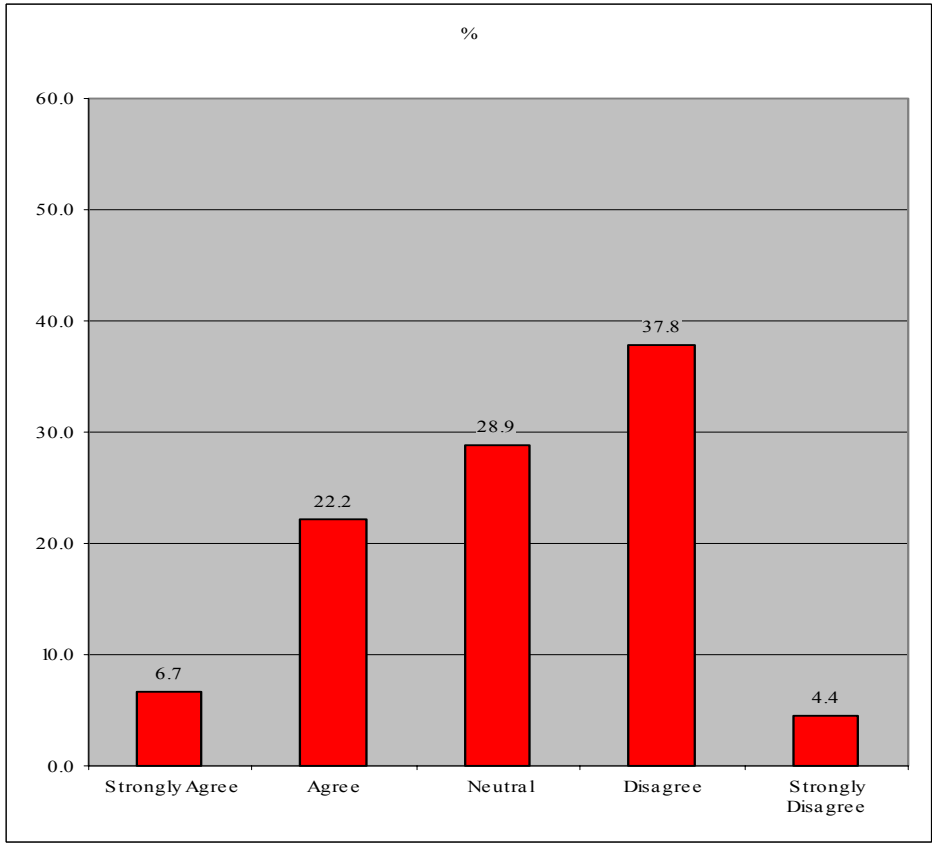


10 - High Quality

0 - Low Quality

- Survey Question 5: Give a Subjective Assessment of GFE Grid Quality Provided by the DGEX.
- Wind of Best Quality
- MaxT, MinT, T, PoP Next
- T_d, RH, Cloud Lowest Relative Quality
- Although Difficult to Tell, Subjective Rankings Above 5 are Likely Favorable

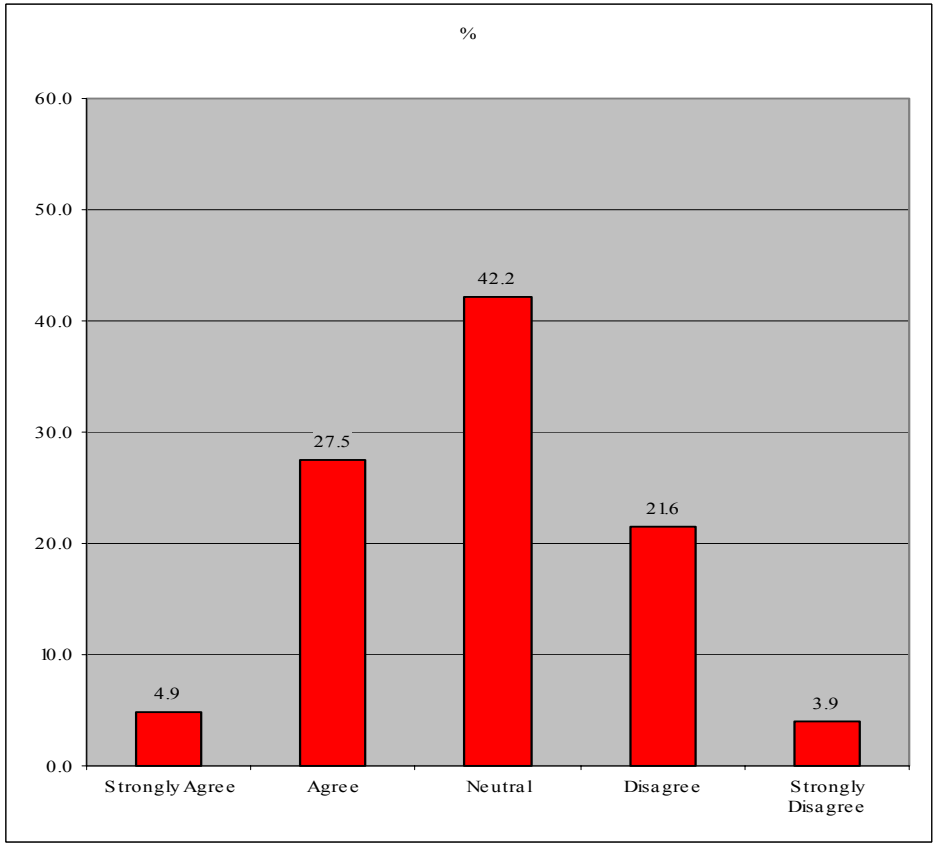
ISST Assessment Results - Daily Survey



- Survey Question 6: Too Much Time Was Needed to Compare the DGEX to the Initializing (18Z) GFS Solution Available Through 120 hrs.

- ~30% Agree
- Over 40% Disagree
- Visit to NCEP Website was Necessary to Complete This Comparison
- Will be Less of an Issue in the Operational Implementation

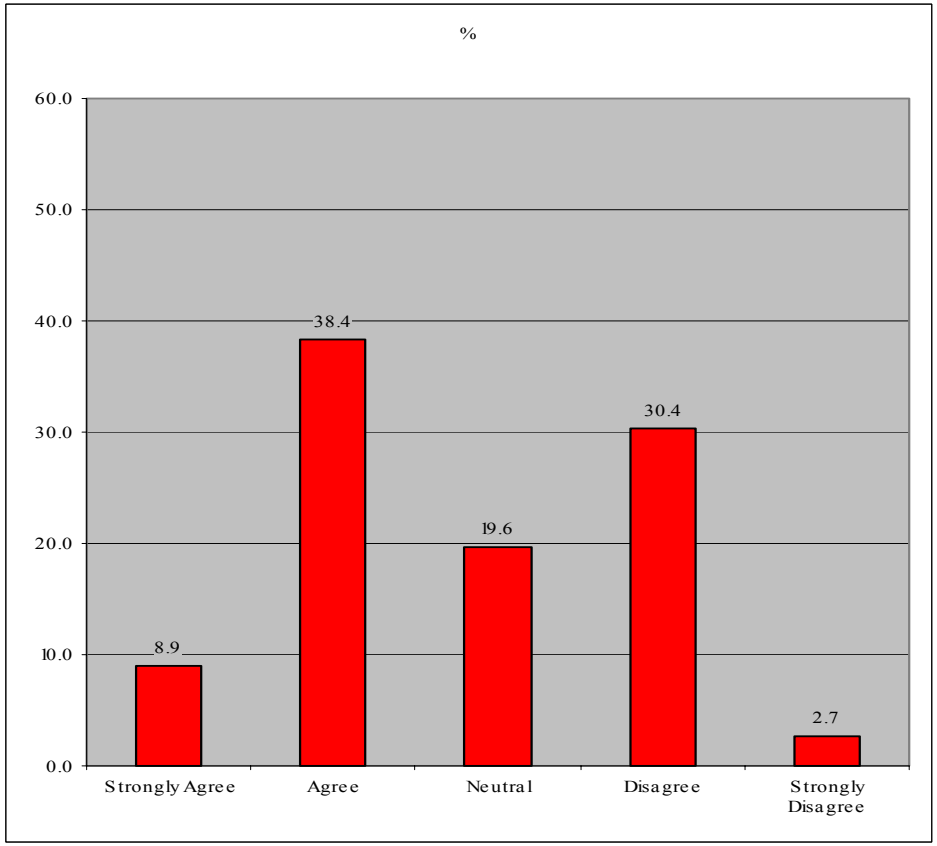
ISST Assessment Results - Daily Survey



- Survey Question 7: Drift Away From the Initializing (18Z) GFS by 120 hrs Reduced the Usefulness of the DGEX.

- ~1/3 Agree
- ~1/4 Disagree
- Trends and Detail from DGEX Were Still Mentioned as Being Useful
- EMC Objective Verification Shows DGEX Equally Skillful to GFS, Suggesting Drift Does Not Reflect a Deterioration in the Solution

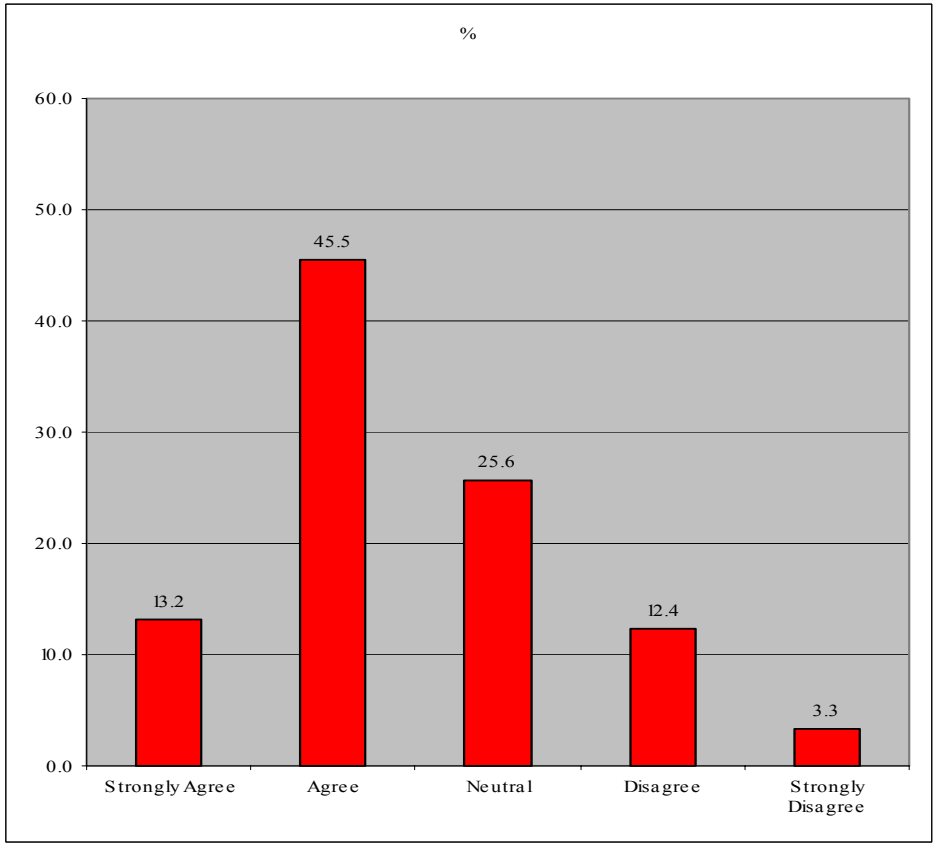
ISST Assessment Results - Daily Survey



- Survey Question 8: Differences Between the DGEX and Latest (00Z) GFS Run Limited DGEX Usefulness in the Forecast Process.

- ~45% Agree
- ~1/3 Disagree
- DGEX Was Often Two Runs Old Compared to GFS
- Will Be Less of an Issue in the Operational Implementation

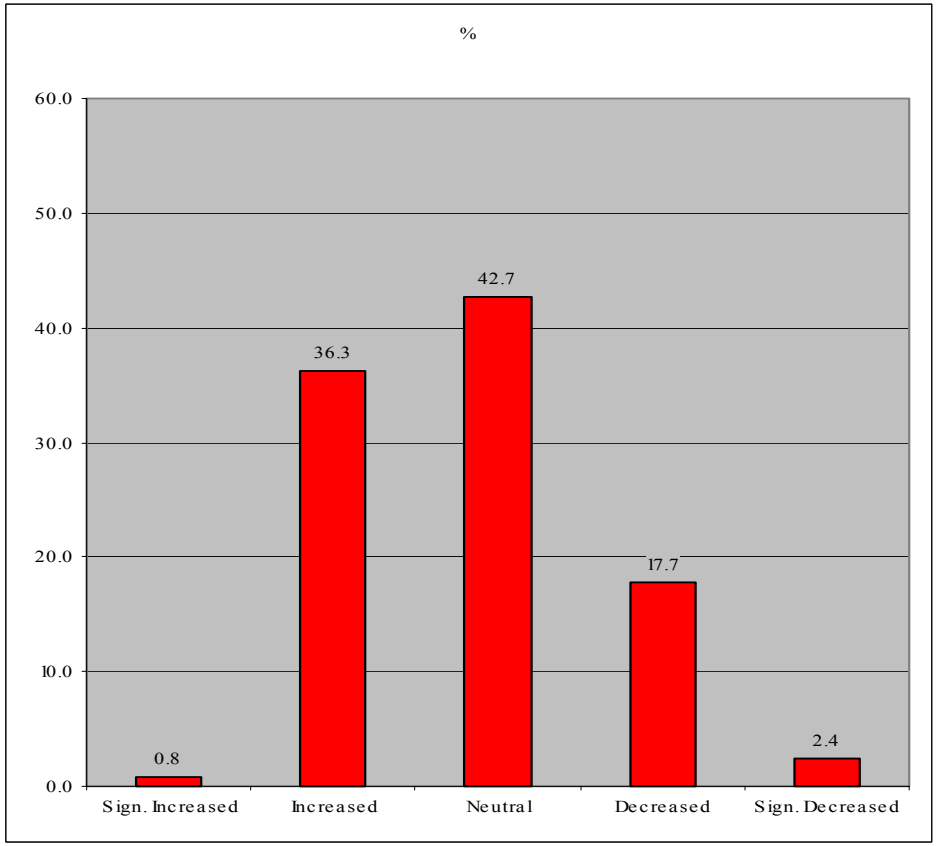
ISST Assessment Results - Daily Survey



- Survey Question 9: Overall, the DGEX Provided Useful Value Over the Latest 00Z GFS Run, Including (Where Applicable) Providing Improved Detail of Terrain, and/or Shoreline/Coastline Effects.

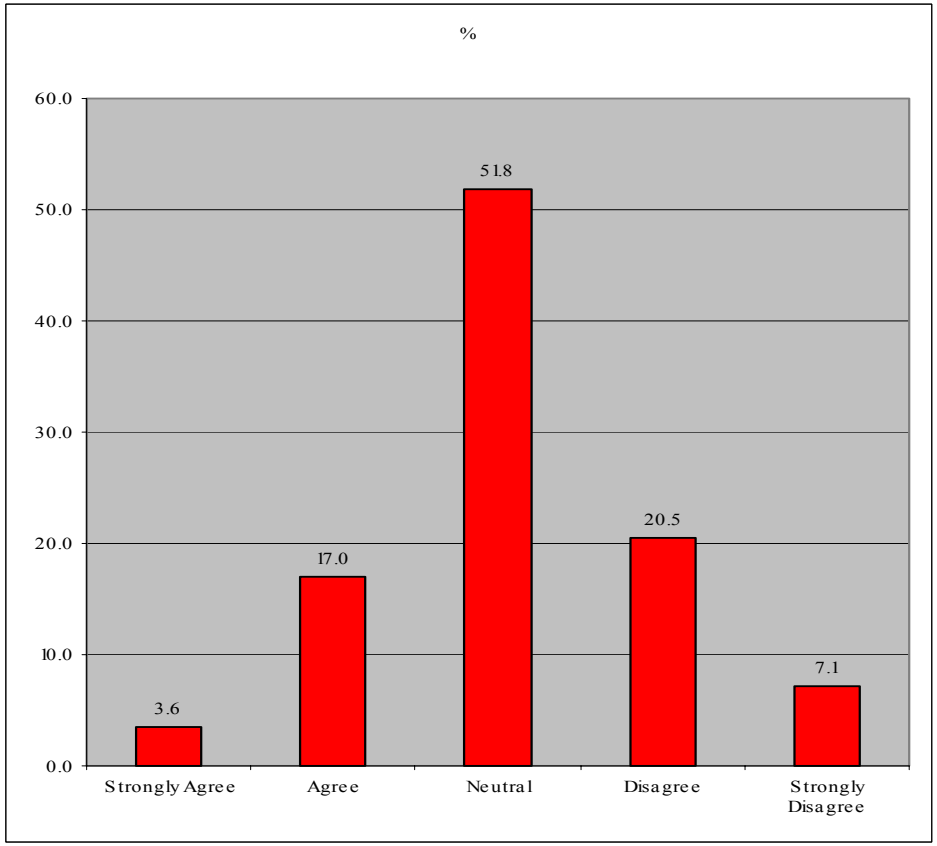
- Only ~15% Disagree
- Nearly 60% Found DGEX Useful
- DGEX Seems Very Useful (Even Given Some of the Timeliness, Data outages, Limited Availability Issues and Drift and Run-to-Run Consistency Issues)

ISST Assessment Results - Daily Survey



- Survey Question 10: Describe Impact of DGEX on the Overall Workload of Preparing Medium Range Grids/Forecasts.
- ~37% Indicated an Increase
  - Expected Given the Newness of This Model
- ~20% Indicated a Decrease
- Expect Decreased Workload in Operational Implementation
  - All WFOs Can Use DGEX for Collaboration
  - Faster to Compare DGEX to the Initializing GFS Run

ISST Assessment Results - Daily Survey



- Survey Question 11: The DGEX Improved the Medium Range Collaboration with Neighboring (DGEX-Participating) WFOs.
- ~25% Disagree
  - Partially Due to Staggered Nature that Data Became Available at Different Offices
- ~20% Agree
- Should Improve During the Operational Implementation Since All WFOs Will Have Access to DGEX

ISST Assessment - Daily Survey Comments

- AFG (3/16): Far superior option to day 4-7 MRF solution. Kept clouds under control and precip field was dynamically consistent with upper air pattern and surface-based QPF. Have been using DGEX for several days now, and it has done an excellent job of toning down the cloud/QPF/PoP excursions of MRF and provide six-hourly valid times rather than 12.

- RNK (3/17): I found the wind direction fields to be one of the more useful items. I also think that DGEX model data can be used to get a hold on trends in extended.

- GSP (3/22): The Day 7winds looked reasonable, but using them would have put us out of line with our non-DGEX neighbors.

- ARX (3/22): Other offices were very interested in it when I mentioned it on the Chat. I found that I get a better sense of the physical processes that are going on in the atmosphere with this model because of its higher resolution.

- MKX (3/23): Models show considerable spread in ensembles today, so run to run variability is high...reducing value of DGEX. However DGEX shows Lake Michigan effects well. Almost too well, since surrounding offices are not using DGEX, so collaboration was difficult. Temps differed more than 10 degrees in some grids over the Lake from our office to the next.

- AFG (3/23): Great details over rough terrain area like Alaska...speckled appearance of sky, cloud, qpf and temps look realistic. Output over Arctic Ocean more old-style monolithic. Really like the handling of winds, coastal and especially in mountains. Thanks for giving us a look at this.

ISST Assessment - Daily Survey Comments

- MKX (3/25): I did like the details in the grids of the DGEX, but it just wasn't the model of choice today.
- EYW (4/4): In GFE, the most valuable aspect of DGEX is the MaxT/MinT/T -- the DGEX output for these elements is decidedly superior to the GFS output.
- ARX (4/5): Fairly large model solution shift between 18z and 00z runs so chose not to use the DGEX solution.
- GSP (4/5): This was my first experience with DGEX but although the workload was increased somewhat, DGEX appeared beneficial to the collaboration process.
- CRP (4/9): DGEX wind/dewpoint offers much better and more realistic grids to populate in the extended periods.
- PDT (4/13): Run-to-run solutions are so variable making DGEX hard to use. Seeing the detail was helpful but DGEX was not used to populate any grids today.
- MFR (4/16): Much better looks on extended fields are a big help. Not sure if neighboring offices are using this; but if they do, this would greatly improve collaboration effort

ISST Assessment Summary

- Majority of Forecasters Found DGEX to be Useful
  - Many Positive Comments on Realism and Value of Forced Mesoscale Detail
  - Wind Grids Were Used Most Often and Deemed to be of the Best Quality
  - Favorable Assessment Even with a Few Drawbacks
    - Timeliness
    - Data Outages
    - Limited Availability

ISST Assessment Summary

- Special considerations
  - Infrequent, But on Occasion, Significant Differences Between DGEX and GFS
    - EMC Objective Verification Shows DGEX and Forcing GFS of Equal Skill
    - Requires Training and Increased Forecaster Experience to Build Confidence

ISST Assessment Summary

- Special considerations
  - Run-to-Run Variability Impacting Usefulness of DGEX (Model Flip-Flop)
    - Underscores Current Imbalance Between Forecast Resolution and Forecast Uncertainty
    - A Synoptic-scale GFS Issue, Not a DGEX Issue
  - Forecaster Workload Did Not Show an Overall Decrease
    - Expected for Any New Model, Especially Given Impact of Assessment Activities
    - Should be Reduced When All WFOs Have DGEX

ISST Assessment Summary

- Recommendations
  - Proceed With the DGEX Operational Implementation
  - Develop Training to be Delivered in Concert with DGEX Operational Implementation
  - Continue Distribution (via Regional WANs) of DGEX Output in the Interim Period (Between Test Period End and Operational Implementation)

NCEP HPC Subjective Assessment

- Assessed by HPC Medium Range Desk
  - Fields Available in N-AWIPS Over CONUS
    - 500mb Heights/Absolute Vorticity
    - PMSL/1000-500mb Thickness
    - QPF
  - Used as Another Model in the Suite of Medium Range Output
  - Typically GFS Was Used as a Reference for the DGEX to be Measured Against

NCEP HPC Subjective Assessment

- Assessment Period Weather Pattern
  - Period Featured a Pattern Over CONUS Loaded with Cut Off 500mb Lows
  - DGEX Seemed to Over Amplify 500 mb Cut Off Lows Too Soon and Drop Them Too Far South of the Westerlies
  - In This Pattern There Did Not Seem to be as Much Run-to-Run Continuity With the DGEX Compared to the GFS

NCEP HPC Subjective Assessment

- General Comments
  - DGEX Output More or Less Followed GFS
  - When Significant Differences Were Noted the GFS Typically Performed Better Than the DGEX
  - When DGEX and GFS Were in Agreement, the DGEX Solution Was Preferred Especially with QPF Fields
  - The DGEX Did Not Suffer from Dramatic Gridscale Feedback Like the GFS

NCEP HPC Subjective Assessment

- Recommendations

"HPC found the DGEX synoptic signal slightly inferior to the GFS over the short evaluation period when used in the medium range forecast process. That alone would typically prevent an endorsement of DGEX by HPC. HOWEVER, realizing that the DGEX is designed to provide benefit to the WFOs on the mesoscale AND that at times the DGEX output followed the GFS, HPC will defer to the WFOs on if the DGEX should be implemented operationally."

Next Steps

- NCEP Currently Exchanging Test Datasets with AWIPS Developers/OS&T SEC As Needed
- Operational Implementation of DGEX Datasets Within AWIPS Dependent on AWIPS OB3.2 Delivery and SBN TG-2 Channel
  - Targeted for June 2004

Summary

- New DGEX Run Has Been Created
- DGEX Currently Running in Production Parallel
- DGEX Fits Within NCEP Production Schedule on IBM CCS Resources
- EMC Objective Verification Shows DGEX Performs as Good or Slightly Better Than the GFS Overall
- Subjective Assessment Shows DGEX Meets Original Objective Intended for NDFD/IFPS Use
- Work Currently in Progress to Get DGEX Products Delivered via SBN to AWIPS